AUSTRALIA'S NUMBER ONE ELECTRONICS MAGAZINE

ELECTRONICS AUSTRALIA

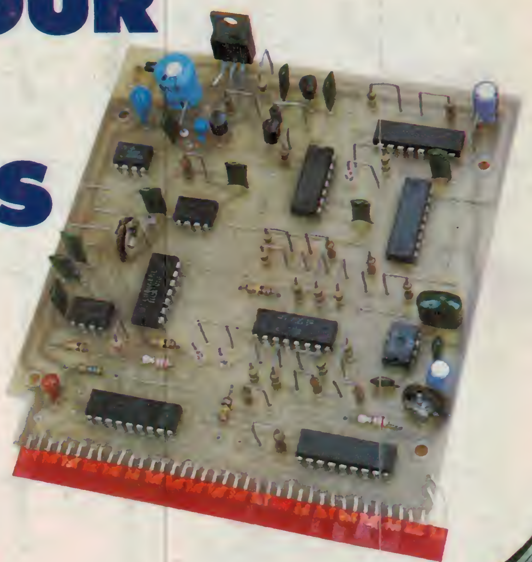
BUMPER 152-PAGE ISSUE

Registered by Australia Post — publication No. NBP0240.

MARCH, 1983

AUST $2.00* NZ $2.50

CHECK YOUR DRIVING WITH THIS FUEL FLOW METER



BUILD A DIGITAL MULTIMETER

BROWN-OUT PROTECTOR

Engineering secrets of the new SMART MISSILES

Power you can taste.

Sony's new TA-AX5 amplifier with memory is a high fidelity feast.

Its multiple memory lets you create your own acoustic "flavours." Bass and treble tone settings, turnover frequencies, high and low filter are all programmable.

At a touch you can instantly recall the recipe for bittersweet country, hot 'n' spicy rock, or a well-seasoned Stravinsky. And electronic displays graphically show you everything the amp is cooking up.

Sony's Audio Signal Processor means that every function is touch controlled. This knifes through the usual maze of audio circuitry for a streamlined design of the future. Pure and simple, it sounds delicious.

The ideal companion for this tasty new amplifier is Sony's ST-JX4 synthesizer tuner. Why not make a reservation for two?

TA-AX5

ST-JX4

SONY®
THE ONE AND ONLY

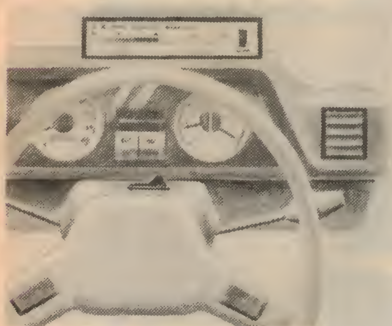
SON 0118

ELECTRONICS AUSTRALIA

Volume 45, No. 3
March, 1983

AUSTRALIA'S LARGEST SELLING ELECTRONICS MAGAZINE

Analog fuel consumption meter



This fuel consumption meter features a LED bar-graph display and displays instantaneous fuel consumption in both litres/100km and litres/hour. Construction begins on page 42.

Want to build a digital multimeter? This unit comes as a complete kit, and features a 3½-digit liquid crystal display and a diode test function. Details p86.

On the cover

Highlighted in the rear-view mirror is the assembled PC board for our new Fuel Consumption Meter. Build it for your car and save petrol (see page 42 & above).

FEATURES

HIFI, VIDEO AND REVIEWS

PROJECTS AND CIRCUITS

PERSONAL COMPUTERS

COLUMNS

DEPARTMENTS

Editorial Viewpoint

Give Cable TV a miss . . . for the time being

In the last six months or so there has been considerable public debate on the subject of cable television and how it might be introduced to Australia. Now, with the Federal election early this month, that debate is likely to cease until the political climate becomes more settled. That is good because it allows a needed cooling off period to get the subject in perspective.

One particular reason why a delay is desirable is that it appears likely that much of the existing cable technology will soon be made obsolete when optical fibres are adapted for this application. As noted in an article on this subject last month in EA, the main problem with optical fibres concerns the linearity of the interfacing devices. But these problems will soon be solved and then optical fibres will have considerable advantages over existing copper cable TV technology.

Not the least of these will be complete freedom from mutual interference between cable TV and the amateur and commercial communications.

But the most cogent reason for desiring a delay in the introduction of cable TV is the massive investment required. In established residential areas, the cost of providing an underground cable network could easily be $1000 per household or much higher. In the present economic climate, contemplation of a cable TV network seems like a flight of fancy or, at the very least, a gross misallocation of resources.

But there is a cheaper way. It would involve Telecom.

Telecom already has an Australia-wide telephone network. Indeed, submissions to a cable-TV enquiry advocated that private enterprise should have access to Telecom ducts. We do not regard this suggestion as being at all practical. But Telecom has a continuous program of replacement of its network and sooner or later it is likely to move over to optical fibres. In fact, this must happen if the network is to continue to increase in capacity.

Once Telecom goes over to optical fibres it has the potential to provide not only conventional telephone services and high speed computer data links, but also the capacity to feed many TV channels into every home in a fully interactive system. And such a fibre optic system would probably also have the bandwith necessary to distribute future high definition TV broadcasts.

So Telecom, that much maligned public monopoly, is well placed to provide a nationwide cable TV network which would be fully integrated with its existing communications roles.

I am not suggesting that Telecom should provide cable TV services. Its obvious role is to provide the network and it should move in that direction as soon as possible.

Leo Simpson

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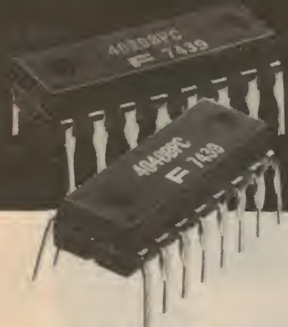

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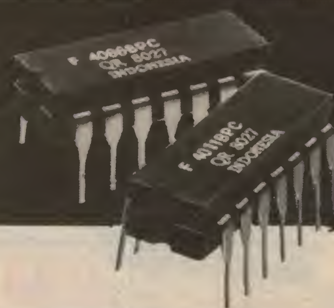

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4022BPC	.44
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4029BPC	.50
4040BPC	.35
4510BPC	.54
4516BPC	.55
4518BPC	.58
4520BPC	.62
40161BPC	.70
40163BPC	.70
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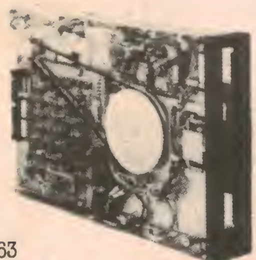

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- NO AC POWER REQUIRED
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4116	150 NS	$1.20
2114	200 NS	$1.20
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Z80	CPU	$3.50
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BU126	1.25	BC327-8	.05	MAN 74A	.68

6800	$2.76	4011	.14
6802	$3.80	4016	.24
6809	$8.10	4017	.44
6821	$1.65	4023	.16
6840	$3.22	4028	.45
6845	$8.50	4040	.52
6850	$1.45	4051	.49
8212	$1.19	4066	.28
8216	$1.05	4081	.16
8224	$1.35	4511	.49
8255	$2.22	4520	.56
8155	$3.80	74LS00	.14
LM301	.22	74LS04	.14
LM308	.29	74LS14	.19
LM324	.37	74LS30	.16
LM339	.38	74LS32	.14
LM555	.20	74LS47	.34
LM741	.23	74LS90	.26
LM340T5	.36	74LS141	.33
LM340T12	.36	74LS240	.49
LM317T	.62	74LS244	.43
LM340K5	.89	74LS245	.57
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78H05K	$3.98	74LS367	.29
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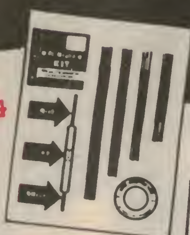
ok WRAPPING TOOLS

WIRE-WRAPPING KIT WK-2

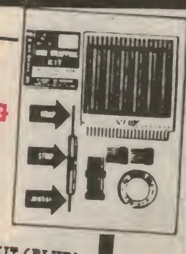


Contains: Hobby Wrap Tool WSU-30, (50 ft.) Roll of wire, Pre-stripped wire 1" to 4" lengths (50 wires per package) stripped 1" both ends

WK-2-B WIRE-WRAPPING KIT (BLUE)
WK-2-Y WIRE-WRAPPING KIT (YELLOW)
WK-2-W WIRE-WRAPPING KIT (WHITE)
WK-2-R WIRE-WRAPPING KIT (RED)

$14.43 + 7.5% TAX

WIRE-WRAPPING KIT WK-3



Contains: Hobby Wrap Tool WSU-30, Roll of wire, R-30B-0050, (2) 14 DIP's, (2) 16 DIP's and Hobby Board H-PCB-1.

WK-3B WIRE-WRAPPING KIT (BLUE)

$18.57 + 7.5% TAX

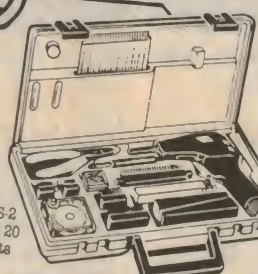
WIRE-WRAPPING KIT WK-4

Contains: Hobby Wrap Tool WSU-30M, Wire Dispenser WD-30-B, (2) 14 DIP's, (2) 16 DIP's Hobby Board H-PCB-1, DIP IC Insertion Tool INS-1416, DIP IC Extractor Tool EX-1 and PC Edge Connector CON-1.

WK-4B WIRE-WRAPPING KIT (BLUE)

$28.90 + 7.5% TAX

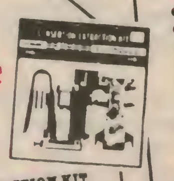
WIRE-WRAPPING KIT WK-5



- Battery Tool BW-630
- Hobby Wrap Tool WSU-30M
- PC Edge Connector CON-1
- DIP/IC Extractor Tool EX-1
- DIP/IC Insertion Tool INS-1416
- PC Card Guides & Brackets TRS-2
- Mini-Shear with Safety Clip MS 20
- 14, 16, 24 and 40 DIP PIN Sockets
- Terminals WWT-1
- Tri-Color Wire Dispenser WD-30-TRI
- Hobby Board H-PCB-1
- Product Catalog

WK-5 WIRE-WRAPPING KIT **$82.69** + 7.5% TAX

INSERTION AND EXTRACTION KIT



The WK-7 contains: MOS-1416, MOS-2428, MOS-40, EX-1 and EX-2. For description of tools see above.

WK-7 INSERTION/EXTRACTION KIT

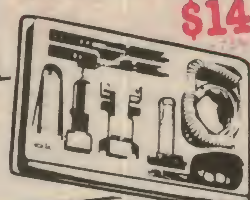
$36.15 + 7.5% TAX

CIRCUIT TROUBLE-SHOOTING KIT

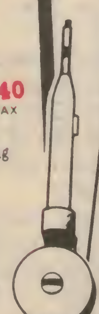
- EX-1 — 8-24 Pin IC extractor
- EX-2 — 24-40 Pin IC extractor
- MOS-1416 — 14-16 Pin IC inserter
- MOS-2428 — 24-28 Pin IC inserter
- MOS-40 — 36-40 Pin IC inserter
- WRS-1 — ANTI-STATIC Wrist Strap
- PRB-1 — Digital Logic Probe
- PLS-1 — Digital Logic Pulsar

WK-8 CIRCUIT TROUBLESHOOTING KIT

$144.74 + 7.5% TAX



JUST WRAP



- AWG 30 Wire
- .025" Square Posts
- Daisy Chain or Point to Point
- No Stripping or Slitting Required JUST WRAP
- Built in Cut Off
- Easy Loading of Wire

REPLACEMENT WIRE SPOOLS **$3.40** + 7.5% TAX

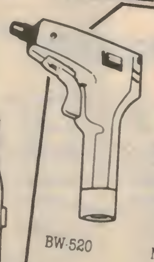
JUST WRAP Wire-Wrapping

TRADITIONAL Wire-Wrapping

JUST WRAP TOOL	COLOUR
JW-1-B	(BLUE)
JW-1-W	(WHITE)
JW-1-Y	(YELLOW)
JW-1-R	(RED)

$16.51 + 7.5% TAX

BATTERY POWERED "INDUSTRIAL" WIRE WRAPPING TOOL BW-520

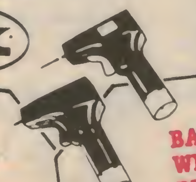


Model BW-520 is a battery operated wire-wrapping tool, also availabe in reversible models for wrapping and unwrapping operations

	Back Force	Wrapping	Unwrapping		Wire Size
BW-520	No	Yes	No	$159 60	AWG 22
BW-520-BF	Yes	Yes	No	$170 44	Thru
BW-520-U	No	Yes	Yes	$183 54	AWG 30
BW-520-BF-U	Yes	Yes	Yes	$194 96	

$159.60 + 7.5% TAX

BATTERY WIRE WRAPPING TOOL BW-630 and BW-2628



For .025" (0.63mm) sq. post "MODIFIED" wrap, positive indexing, anti over-wrapping device. Complete with Bit and Sleeve.

BW-630	FOR AWG 30	$38.22 + 7.5%
BW-2628	FOR AWG 26-28	$44.42 + 7.5%
BT 30	BIT FOR AWG 30	$4.34 + 7.5%
BT-2628	BIT FOR AWG 26-28	$8.78 + 7.5%
BW2630	FOR AWG 30 and AWG 26-28	$22.72 + 7.5%
	Supplied less bit and sleeve	

REPLACEMENT WIRE SPOOLS **$3.40** + 7.5% TAX

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News Highlights

The transistor — 35 years of technological change

This July will mark the 35th anniversary of the announcement of the development of the transistor by Bell Laboratories.

The transistor was invented by John Bardeen and Walter Brattain, working under the guidance of William Shockley, and switched on for the first time just two days before Christmas, 1947. It attracted little attention at the time although it won its inventors the Nobel Prize in 1956.

Bardeen recorded details of the first transistor circuit in his notebook: "This circuit was actually spoken over and by switching the device in and out a distinct gain in speech level could be heard with no noticeable change in quality".

Until the arrival of the transistor, all electronic equipment was based on thermionic valves. In 1952 the electronic valve industry reached its peak. The industry was producing around 200 million valves a year, the first commercial computers were going into production, each requiring about several thousand valves, and manufacturers were confident of a bright and prosperous future.

Bell introduced the secrets of the transistor to the world at a symposium held in 1952, charging an admission fee of $25,000 as an advance on royalty payments. Despite the high price of admission, almost 40 companies sent representatives to receive a two volume book called Transistor Technology, compiled by the original developers. Within a short time, dozens of transistor manufacturers had sprung up and the first product incorporating transistors was on the market – a portable radio.

Texas Instruments, in collaboration with a now defunct company called Regency, were the first to launch a transistor radio, although Sony Corporation was not far behind. Masaru Ibuka, one of Sony's founders, happened to be in the US when Bell held the symposium and was able to persuade the Japanese government to allow the payment of $25,000 to obtain manufacturing information. Within two years Sony had made its first transistor.

Valve manufacturers were astounded at the speed at which mass production of transistors began and the effect that it had on valve sales. By 1956 there were 164 different types of transistors on the market.

TRANSISTOR INVENTORS Bardeen, Shockley and Brattain (left to right) shown in 1948 with the original test setup.

The next major breakthrough was achieved in 1959 with the production of the first integrated circuit. Jack Kilby at Texas Instruments claims to have produced the first circuit, although the idea of etching several components onto a single piece of silicon had been conceived years before. It was Fairchild, however, with its experience in optics, that invented the manufacturing process from which modern chips are made.

The first integrated circuits contained only half a dozen components. Today about 450,000 individual components can be etched onto a single piece of silicon less than 2mm square.

Cyber 205 "supercomputer" for CSIRO

The CSIRO will join an elite group of organisations with the installation of what is considered to be the world's fastest and most powerful computer, the Control Data Cyber 205. Only eight of the "supercomputers" are in use mainly in the United States and the CSIRO's machine will be the first such installation in the southern hemisphere.

Announcing the acquisition, the Minister for Science and Technology, Mr David Thomson, said that the Cyber 205 would be a significant advance in computing power for the CSIRO. The machine can process up to 400 million calculations per second, and operates by carrying out various processes in parallel.

Similar computing processes would require about 100 seconds on CSIRO's current Cyber 76 computer, which remains one of the fastest computers in Australia almost 10 years after installation.

The new machine will be installed at the CSIRO's Division of Computing Resources Research in Canberra and linked to the organisation's nationwide data network, CSIRONET. Applications will include analysis of geological data, weather forecasting, chemical studies and oceanographic research.

AUSTRALIAN ASTRONAUT TO FLY IN SPACE SHUTTLE


ARTIST'S CONCEPT OF SHUTTLE SATELLITE LAUNCH

According to a recent announcement from Canberra, an Australian astronaut will go into space aboard the Space Shuttle in 1985 for the launch of Aussat Australia's domestic communications satellite. NASA recently won the $US37 million contract to launch Aussat, beating off a major challenge from the European Ariane rocket launcher.

The Department of Science and Technology, in conjunction with NASA and AUSSAT, will select two Australians for special training for the flight, one as the passenger and the other as a back-up. Both will be satellite systems experts.

Commenting on the announcement the Minister for Science and Technology, Mr David Thomson, said that Australia was one of the first countries to receive such an invitation. He described the invitation as "tribute to the high standards which Australia has maintained in past co-operation with the US space program". Previous space shuttle flights have relied heavily on tracking data from the stations at Tidbinbilla and Orroral Valley in the ACT.

The first non-American to fly in the shuttle will be a West German astronaut who is scheduled to fly with Spacelab 1 later this year.

Meanwhile, a NASA team investigating the failure of two space suits during an attempted space walk on the fifth space shuttle flight has blamed faulty assembly for the problems. During the mission on board Columbia an oxygen regulator in Astronaut William B. Lenoir's suit failed to provide suit pressure, and the fan motor in another space suit refused to function.

Although cause of the motor failure has not yet been determined, the report says that two vital parts had been left out of the oxygen regulator during assembly by the vendor of the suits. Documentation indicated that the parts had been installed and repeated tests failed to show up the missing parts.

TOSHIBA SUPERCHIP!

Toshiba Corporation has announced the production of a hybrid VLSI circuit that incorporates nine 256K byte read only memories in one package. What's more, the company is using the new device in its latest office information processing equipment, where it is used as a pattern generator for more than 3000 Chinese, Japanese and European characters.

A second ambitious hybrid from Toshiba combines 32 64K CMOS random access memories into the one device. Toshiba says it plans to use the device as a memory array in an experimental high-definition display of still television pictures.

Home computers may save videotex

Home computers may save the videotex business according to a new report from International Research Development, a US marketing research firm. The biggest stumbling block so far for video information service providers is the lack of installed terminals, but there are over two million microcomputers in place in US homes.

As IRD researcher Steve Weissman puts it: "The problem today is that so-called 'videotex' providers are at base trying to sell videotex terminals to subscribers at a time when there's really nothing very exciting to access. Personal computer owners, however, have already found a need for their equipment and have already made their purchases. Thus service providers can concentrate on providing worthwhile service instead of worrying about how to get the hardware into users' hands."

In 10 years' time, the report predicts, around 50 million US households – half of the total – will have a microcomputer. Of these, around 14 million will have some sort of communications capability. The IRD researchers see some nine million households accessing videotex with a computer, with only four million using dedicated videotex terminals.

IRD sees the biggest area of demand being for the sort of information currently provided by classified telephone directories and newspapers, such as movie listings, restaurant guides and accommodation vacancies. According to the firm, satisfying this demand could be a $US640 million business by 1992.

Car won't go? — shield the antenna!

A radio amateur in the United States has an unusual problem with his new car – and has received some unusual advice on how to deal with it.

The amateur found that the eletronically controlled carburettor of his 1982 Subaru behaved strangely whenever he transmitted on the amateur bands from the vehicle. He wrote to Subaru detailing the problem and their reply was to recommend that radio transmission equipment including CB transceivers, garage door openers, perhaps even radar detectors, not be installed in any 1982 Subaru since they will result in "erratic driveability". Their advice on how to handle the problem perplexed the car's owner: "Shielding the antenna may also help to cut down on interference". Seems that they hadn't heard of shielding the electronic carburettor!

NEWS HIGHLIGHTS

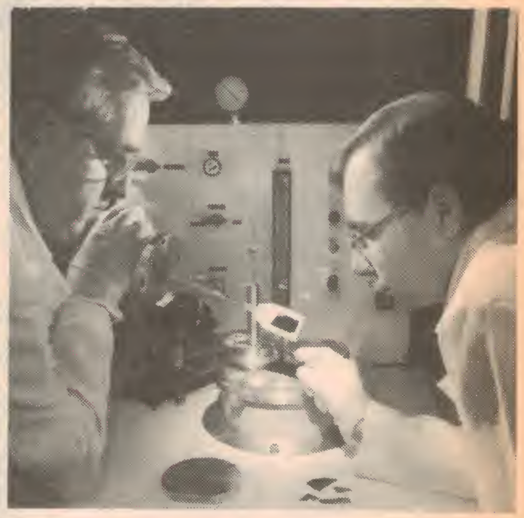
New FET design speeds switching circuits

Scientists at the US General Electric Corporation recently reported the development of a new high voltage Field Effect Transistor fabricated from gallium arsenide. The prototype device boasts switching speeds of 5ns and can block up to 150V — as against 85V of previous GaAs FETs.

The new FETs also have an on resistance one-tenth that of comparable silicon devices, reducing power losses in switching circuits.

The design of the new FET is unusual. Most gallium arsenide devices are horizontal, with the source, gate and drain aligned on top of the chip. GE's design places a large source contact on the top and a large drain contact on the bottom of the chip with fine gate regions through the centre.

The structure and fabrication of GE's prototype devices was described in a technical paper presented at the International Electron Devices meeting held in San Francisco in December.



Readying a sample of gallium arsenide for processing in an annealing furnace are physics specialist Roger S. Ehle (left) and physicist Dr Paul M. Campbell, of GE's Research and Development Centre, NY.

Robots go to work for Rolls Royce

Robots are going to work for Rolls-Royce in the company's aerospace factory in Derby, UK, producing turbine blades for the Rolls-Royce 535C engine that powers Boeing 757 airlines.

The introduction of the robots follows from the company's decision to concentrate on the manufacture of high technology and high cost engine parts which are produced in relatively large quantities. Robots will allow such parts to be produced more cheaply, with better quality control and at a faster rate, while providing the flexibility to alter designs at short notice.

The newly installed robot line is divided into seven "cells" for work on different parts of the blades. Each cell contains a programmable robot for handling the blades, two grinding machines and automatic cleaning and inspection facilities. A central computer monitors overall production and quality control.

Altogether the turbine blades undergo 12 separate operations before humans take over to finish them, but Rolls-Royce says that the remaining operation can and will be automated.

In Australia, the Department of Science and Technology's project to encourage the use of robots in manufacturing has resulted in the publication of a report "Development of Robotic Technology in Automated Handling of Parts", which is currently available from the Department.

Under its "Industry Productivity Improvements Program", the Department has already provided assistance to ASEA Industries Pty Ltd for a project to design, install, operate and evalute industrial robots suitable for Australian manufacturing operations.

The first report of the project provides information on the problems of installing and operating industrial robots and demonstrates the feasibility of applying them to Australian manufacturing. Cost of the report is $12.50, payable to the Department of Science and Technology. Interested readers should send orders to Ross Parker, Department of Science and Technology, PO Box 65, Belconnen, ACT, 2617.

New standards cover circuit symbols

The Standards Association of Australia has published three new editions of its standard dealing with graphical symbols for electronic drafting.

The three revised editions cover resistors, capacitors and inductors, semiconductor devices and power, and communications installations. They incorporate amendments to previous editions, new symbols and the re-numbering of symbols in accordance with the current IEC method.

Copies of the standards can be purchased from SAA offices in capital cities and Newcastle.

Simulator tests Shuttle programs

After several embarrassing delays to shuttle launches due to software defects the National Aeronautics and Space Administration (NASA) has begun using a simulator to test new Space Shuttle flight control programs.

A software failure in flight during a Space Shuttle mission would doom both the craft and the crew, as there are no analog or manual back-ups to the Shuttle's five-computer "fly-by-wire" system. Software verification is an essential part of any Shuttle mission.

The simulator, Space Shuttle No. 098, has actually completed more missions than its better known sister ship Columbia (officially known as Orbiter 102). It is located in Building 16 of the Johnson Space Centre in Houston, scattered in pieces throughout the test laboratory.

There is little that is actually mocked-up in the laboratory. "We are using the same vehicle harnesses, wires and bus connectors so that the devices will be positioned in the proper 3-d full-scale arrangement . . . It is though you had rolled an orbitor into the building, taken away the fuselage and left just about everything else" says Jon H. Brown, chief of the Shuttle Avionics Integration Laboratory which is performing the tests.

There is even a full size payload area that allows the laboratory to test software interfaces that connect with satellites which will be placed in orbit.

Japanese court rules on software copyright

In a decision with far-reaching consequences for the Japanese data processing industry, the Tokyo district court has ruled that computer programs come under the protection of copyright law.

The court took the standpoint that computer programs are "original works" as required to bring them within the extent of copyright legislation. The ruling involved the video game Space Invaders Part II, manufactured by Taito Corporation. Another firm, Ing Enterprises, copied the game's Read Only Memories and used them in 27 units that it assembled. The court ordered Ing Enterprises to pay Taito $US2160 in damages.

Other courts, notably in the United States, have ruled that computer programs in machine language cannot be copyrighted, essentially because they are unreadable without the intervention of a machine. It is unlikely, however, that the Japanese decision will be followed outside of Japan.

George Tillett 1913-1982

George Tillett in mid-career

It is with deep regret that we record the death, recently, of our regular correspondent in the USA, George Tillett. Still a "young" 69, George was struck and killed by a car at about the very time that we were preparing what proved to be his last article for us — "Loudspeakers", in the January issue.

Loudspeaker design was probably George's pet subject and it was the context in which our paths first crossed, at a personal level, around 1968. At the time, he was Technical Director of Wharfedale — a company which, in those days, had strong hifi links into Australia.

But, long before then, George had won a place as one of that rather unique group of personalities who typified the spirit of Britain's electronics industry for something like 40 years. They were hobbyists at heart, engineers by accomplishment, and managers by necessity!

George Tillett's early career is set out in "Audio Biographies" by G. A. Briggs, the founder of Wharfedale Wireless Works, himself a devotee of hifi in the home, and one of the most venerable of Britain's hifi pioneers.

He records that George W. Tillett was born in Norwich in October, 1913 and, after attending Wolverton Technical College, spent the years 1930-1936 gaining practical experience at the test bench "in various firms".

In 1936, George Tillett became a partner in the firm of Crescent Radio which, perhaps predictably, diversified into custom-built high quality audio systems.

Their most memorable order was placed on behalf of an Italian gentleman named Mussolini, who supplied a special cabinet crafted in Milan — and then joined in a war which had the indirect effect of putting Crescent Radio out of business!

For the duration of the war, George Tillett worked in a laboratory situation and then, following another brief foray into private business, joined Pye as engineer in charge of VHF projects. In 1951, he moved to Armstrong Wireless and Television as Chief Engineer.

Subsequently, he transferred to Decca Radio & Television Ltd as Chief Audio Engineer. It was during this period that the 45/45 system of stereo recording was developed by Arthur Haddy, using much of the refined technology that had gone into Decca's ffrr quality recordings.

After seven years with Decca, George Tillett became Chief Engineer of the Daystron Division of Heathkit — an operation which, in those days, dwarfed any kit retailing activity we had seen in Australia. After eight years with Daystron, George joined Wharfedale but it was at a time of instability for that company, occasioned by changing conditions and changing management.

Then, much to my surprise, George quit England and crossed the Atlantic to become Chief Engineer of Fisher Radio in Pennsylvania where he set up that company's loudspeaker manufacturing plant. After that came an appointment as Executive Vice President of Audio Dynamics Corp, in Connecticut where he fathered the 303-AX loudspeaker system. From there, he took the position of Editor of "Audio" magazine, followed by a further move to Massachusetts as Vice-President Engineering for Epicure.

But, by 1975, at age 63, George seemed to have had enough of hifi business pressure and the next letter I had from him said that he had settled down in Clearwater, in "sunny" Florida, in the role of a consultant and freelance writer.

Perhaps "settled down" is an overstatement because he still did his share of jetting to conventions and exhibitions and supplying articles to a string of magazines, including "Electronics Australia".

But George is no longer with us and we will miss his letters and his always perceptive reports on the ever-changing world of audio and video. He is survived by his wife Patricia, his daughter Elizabeth and a son Richard. (W.N.W.)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Alan Blumlein: wartime radar pioneer

A Halifax bomber crashed 40 years ago, 10km from Ross-on-Wye in England, killing 11 people. One of them was Alan Blumlein, one of Britain's most prolific engineers, and who invented vital radar equipment used by the British during WWII.

by BARRY FOX

DO YOU KNOW who devised the first electronic television set? Or who invented stereo sound? Or even who made the crucial innovations that made radar work? It was the same man who made stereo sound on film tracks a reality and who designed the basic electronic circuits that much modern electronic equipment still uses today. His name? Alan Blumlein, a Briton, who was 38 when he died on June 7, 1942.

If you've never heard of Blumlein, you are in good company. For a host of curious reasons, varying from official secrecy to company policy, his name is familiar to relatively few people, mostly enthusiasts in the field of electronics. Details of his achievements are known to even fewer.

By the time he died, Blumlein had filed 128 patents, an average of one every six weeks of his working life. While most engineers specialise in one area, Blumlein contributed to virtually all areas of electronics. Marcus Scroggie, author of today's standard works on electronic circuits, describes him as "the greatest circuit designer and originator ever".

In his short life, Alan Blumlein devised circuits to prevent adjacent telephone lines interfering with each other, and electrical measurement circuits so accurate that they could sense the altitude of an aircraft by detecting the capacitance between it and the Earth. He designed innumerable filters and amplifiers that have become standard building blocks for the electronics industry.

He worked, under Isaac (later Sir Isaac) Schoenberg, to develop the world's first electronic TV system. The BBC used it for the transmissions from Alexandra Palace which began in November 1936. Modern TV still uses most of the same basic technology. Soon after Blumlein's death, Schoenberg told a colleague "there was not a single subject to which he turned his mind that he did not enrich extensively".

In the early 1930s, Blumlein developed and patented a stereo system on which the world finally standardised in 1958. All today's stereo relies on the same principles. His patent on stereo, BP 394 325, is a bible for audio engineers. Philip Vanderlyn, who worked under Blumlein at EMI's Central Research laboratories, in Hayes, and steered EMI into stereo 20 years later when the world caught up with his ideas, says of the patent: "It pre-empts all further useful reasoning on the subject".

English engineer Alan Blumlein (1903-1942).

After successfully cutting two channels into the single groove of a disc record in 1933 and 1934, Blumlein went on in 1935 to record two channels of sound in the optical track of a motion picture film. He did so more or less as a casual aside to developing 405-line television. Dolby Labs, the US electronics company known world-wide for its noise reduction systems, has recently revolutionised cinema sound by developing a stereo system based on optical sensors. This is so similar to Blumlein's original format that, Dolby engineers say, one of Blumlein's 35mm stereo optical films would play on the standard stereo optical film projector installed in many modern cinemas.

From television it was a logical step to radar. The work probably started well before the Second World War. Before he died, Blumlein had made seminal contributions first to "airborne interception" radar, and then to "plan position" radar, the airborne navigational aid that displays an image of the ground below. Sir Bernard Lovell, in charge of these projects later described Blumlein as "one of the best electronics engineers which Great Britain has ever produced". Sir Alan Hodgkin, who was also involved in the radar project for five years, has told how the use of Blumlein's radar inventions in the North Atlantic reduced the loss of shipping due to German submarines from 400,000 tonnes in March 1943 to less than 50,000 tonnes three months later.

When Blumlein died the Government postponed even a brief announcement

Avro Lancaster bombers were among the first aircraft fitted with the PPI radar sets.

for three years, because it feared that the news of his death would give solace to Hitler – then seriously disturbed by the effect British radar was having on Germany's U-boat campaign.

There is no simple explanation for Blumlein's lack of recognition. There is just an unfortunate but fascinating set of circumstances which have conspired to deny the man the place in history which he deserves.

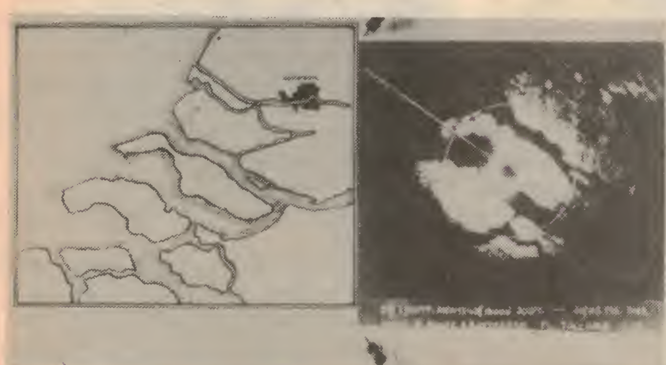
Perhaps the most relevant factor is the Official Secrets Act. Because he died while working on military hardware the Act has hampered historical research. The people he was working for either kept inadequate records or have since destroyed or lost them. Many of his colleagues are now dead. So no one really knows what Blumlein was doing between 1937 and 1939. Although still on EMI's payroll when he died, Blumlein was working for the Telecommunications Research Establishment or TRE at Malvern. This is now the Royal Signals Radar Establishment. Although RSRE says most of the papers on Blumlein would now be unclassified (under the 30-years rule), wartime TRE personnel were notorious for not keeping records and there is no original TRE material on Blumlein. The problem is exacerbated because Blumlein was employed by EMI not TRE.

From an historical point of view Blumlein suffered a disadvantage by working for EMI, now Thorn-EMI. The company is known for keeping details of its own history to itself. Although it possesses one of the best collections of old equipment, and archives, the company has done little with them. It has files, which in historical value are priceless, of original notes made by Blumlein and his colleagues in the 1930s. These are jealously guarded, but EMI has never explained why. Original equipment, such as that used to record stereo sound on film and disc was thrown away years ago. The reason? "In the current economic climate, our first concern must be today's sales and tomorrow's products. Research into archival information cannot be given foremost priority," says Thorn-EMI's David Sowter.

The stereo-optical sound films Blumlein made in 1935 are still on nitrate stock. This is not only dangerously explosive but also becomes sticky and loses its image with the passage of time. The National Film Archive, part of the British Film Institute, believes that even under ideal storage conditions, Blumlein's material dating back to 1935 must be on the point of irreversibly degrading. Although Thorn-EMI has been promising for five years to transfer the nitrate originals onto the safe, acetate stock, the company says merely that the work is "in hand". The problem, says Thorn-EMI, is that it is being undertaken by "an expert" who is busy with other things.

There is another reason why Blumlein's life and work remains a secret to the world at large. Whereas most pioneers are the subject of at least one biography, there is still no book on Blumlein, something of a mystery in itself. In 1967 Basil Benzimra, an engineer who decided to immortalise Blumlein, called for reminiscences about him to be sent to his son Simon Blumlein. A year later, at a seminar on Blumlein's life organised by the British Kinematography Sound and Television Society, Simon Blumlein spoke with affection about brief memories of his father, and said how he hoped with Benzimra, to write a biography.

Ill health forced Benzimra to abandon the project and it was taken over by Francis Paul Thomson, author of books on banking, the Giro money system and tapestry. In September 1973 the authoritative magazine, *Wireless World*, carried a letter from Rex Baldock, organiser of the BKSTS memorial meeting, suggesting that anyone with information on Alan Blumlein should send it to Thomson at his Watford address. At the unveiling of the Blumlein plaque in 1977, Thomson told how he had been "persuaded to write a biography".



The photograph above demonstrates the quality of the images received from even the early Plan Position Indicator radar. At right is a PPI installation in the cockpit of a Mosquito fighter of 1942.

Alan Blumlein: wartime radio pioneer

The all-black Mosquito night-fighter prototype, W4052. The radar antenna was an arrow-head design mounted in the nose between machine guns.

According to Thomson, in a letter to Huddersfield Polytechnic, he has accumulated about 80kg of material about Blumlein and his inventions and researched the inventor's ancestry back to the early 15th century. The 1982 edition of *Who's Who* contains an entry in Thomson's name referring to a book on Blumlein called "Engineer Extraordinary" published in 1977. But the Science Reference division of the British Library can find no trace of any biography of Blumlein. Thomson has declined to say when he will publish his biography, or list any articles on Alan Blumlein that he has published since he started to collect biographical material nearly 10 years ago.

But what sort of man was Blumlein and what do we know about him? He was born in Hampstead, North London, on June 29, 1903. He won a scholarship to Highgate School, where he studied science. From Highgate the young Blumlein went on to win a further scholarship to City and Guilds where at the age of 20 he got a first class honours degree in heavy electrical engineering. He stayed on at City and Guilds as a demonstrator where he helped to develop a method of measuring electrical resistance using high frequency signals. Blumlein, still only 21, described it in a paper to the Institution of Electrical Engineers.

In September 1924 Blumlein joined International Western Electric, a foreign subsidiary of Bell Laboratories, later to become Standard Telephones and Cables. His job was to improve long distance telephone lines. He worked obsessively hard, inventing a solution to every problem that he encountered. In 1929 Blumlein, looking for work outside the telephone field, joined the Columbia Graphophone Company and worked under Isaac Schoenberg. His brief was simple: find a way round some patents owned by Bell and Western Electric on the then-new system of recording sound electrically. This used a microphone, an amplifier and an electric cutter head rather than an acoustic horn and diaphragm driving a stylus. All the companies who were recording electrically had to take out a licence on the US patents.

"One of Blumlein's many contributions was the video waveform".

Coming straight from the folds of Western Electric, Blumlein was obviously in the ideal position to seek a way round the patents. He did so by designing a completely new system, with a moving-coil (electromagnetic) microphone, a novel amplifier and a moving-coil cutter head. It is interesting to note that in recent years the hi-fi world has suddenly discovered the virtues of moving coil cartridges.

In 1931, Columbia merged with another firm, called The Gramophone Company, which was famous for the "His Master's Voice" record label. The result of the merger was Electrical and Musical Industries, later to be called just EMI, and ultimately (in December 1979) to be merged with Thorn. In the 1930s, EMI was famous for its research laboratories at Hayes. It was there that Blumlein worked. He continued to improve his disc recording system, extending the frequency range to around 10kHz and then turned his attention to stereo.

If there were any justice in this world, Blumlein, or at least his employers, EMI, would have benefited from the original master patent on stereo, BP 394 325. But Blumlein, like the Bell Lab engineers who were working and patenting along similar lines in the US at the same time, was too far ahead of his time. The files of the British Patent Office tell a fascinating story. BP 394 325 was kept in force by EMI for the whole of its legal life of 16 years, despite there being no commercial demand for what it protected. In 1947 the patent expired, but at the same time EMI applied to have its life extended.

The British Patent Office, taking into account commercial losses due to the war years, extended the patent for five years. So BP 394 325 did not finally expire until December 13, 1952. But it was still too early. The first discs came onto the market in 1958. But by then the patent, on which EMI could have claimed royalties on the system, was dead and could no longer be extended.

The television system that EMI developed in the 1930s was a remarkable achievement. Equipment installed for the first transmissions in 1936, were still in use in 1950. The 405-line standard is still being used for some transmissions in Britain.

But the inspiration for the 405-line standard came from a considerably less ambitious proposal. In 1934, a government committee under Lord Selsdon recommended that Britain should have a television service, based on 240-line pictures using John Logie Baird's mechanical scanning system. Isaac Schoenberg decided to knock the Baird mechanical system on the head once and for all. He committed Blumlein, and his fellow engineers, to developing the 405-line standard. Although this looks poor alongside today's 625-line pictures it was a remarkably tough target in the mid-1930s.

One of Blumlein's many contributions was the video waveform, in which the picture information and the synchronisation pulses were all interwoven into one signal on a single frequency. The Blumlein waveform — to which engineers later added a colour signal — has become a world standard which is still in use today. It took just 18 months

Alan Blumlein: wartime radio pioneer

to design, develop and install a working system ready for the BBC launch in November 1936. By May 1937 the EMI team had produced outside broadcast equipment which could transmit King George VI's coronation – the first ever television broadcast from outside a studio.

In January 1935, while the EMI team was starting work on the 405-line all-electronic TV system, Robert (later Sir) Watson-Watt was working on a committee, chaired by Henry Tizard, for the Scientific Survey of Air Defence. They were looking for a "death ray" to defend against air attack.

But in February 1935 Watson-Watt wrote his now famous memorandum saying that although it was impossible to destroy aircraft by radio waves, it should be possible to detect them by radio energy reflected from the aircraft's body. Using BBC's transmitter at Daventry, he proved that detection by reflection was possible. Immediately, in the early spring of 1935, the whole project was covered with a security blanket of high secrecy.

It is unclear exactly when Blumlein and the EMI team became involved in the development but he filed many patents on radar circuits in the late 1930s, even though (for security reasons) they were not printed until 1946 and 1947. And we do know that by 1940 Blumlein had designed the Air Interception (AI) radar system, which operated automatically.

By the spring of 1941 they had improved the accuracy of AI radar sufficiently for one aircraft to detect another in the air several kilometres away. But it is likely that from as early as 1937, Blumlein's real aim was to develop a "plan position indicator" an airborne radar, that could display a picture of the ground or sea below. Some people believe Blumlein succeeded in this as early as 1938.

Accuracy and clarity of the image depended on the frequency and power of the signals used. The higher the frequency, the smaller the wavelength, the smaller the aerial needed, and the higher the resolution of the system. The breakthrough came with the invention of the magnetron and the klystron; the former was a carefully sculptured chamber within which high frequency oscillatory signals of great power could be generated; the klystron was an electronic circuit that achieved the same result, but with less efficiency. By early 1942 the work on the plan position radar (code-named H_2S) by EMI at Hayes and TRE at Malvern was bearing fruit.

On June 7, 1942 Halifax V9977 took off from Defford crammed with experimental H_2S gear. There were five crew members, half Sir Bernard Lovell's engineering team and three men from EMI, including Blumlein. There was no EMI gear on V9977. But there had been much debate over whether the H_2S test flights should use magnetrons or klystrons. Winston Churchill was worried in case the magnetron, which was virtually indestructible, might fall into enemy hands if there should be a crash.

The fated bomber, Halifax V9977, was fitted with a magnetron and the flight on June 7 was made solely so that the EMI team could see how the prototype H_2S magnetron equipment worked at high altitude.

The Halifax was flying at around 2500 feet when disaster struck. The starboard outer engine failed, because an inlet valve fractured due to metal fatigue. This engine was driving the generator which supplied power to the H_2S equipment. So instead of feathering the propeller, the crew tried to re-start its engine. But it caught fire. The crew then tried to put out the fire, but found the extinguishers had not been filled. The plane crashed at 4.20pm killing everyone on board. The only piece of equipment to survive the crash was the magnetron. But it did not fall into enemy hands.

Today, plan position radar, like AI radar, television, stereo sound and numerous electronic circuits designed by Blumlein are taken for granted. It would be fitting to end on the note that although Blumlein died young, his inventions live on. But sadly, although his name will doubtless be found on a few commemorative plaques, his memory is revered only by a handful of people who have taken the trouble to read what they can about his life and work. The real tragedy of Blumlein's life is that by the time we wake up to his genius it will be too late to document that genius for posterity.

An original "Emitron" camera tube, as used for the first regular TV service, 1936.

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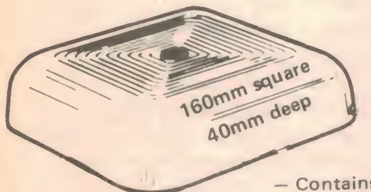

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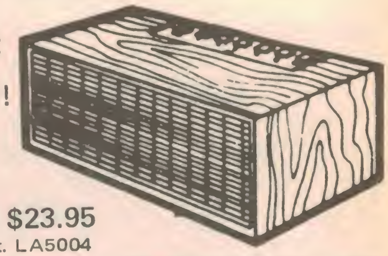

FROM $23.95
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BACK TO TECH BREADBOARDS

Many of the Tech Colleges and CAE's are specifying plug-in bread boards as training aids in their Electronics and Radio courses. At around March Breadboards get VERY scarce as thousands of students buy all available stocks. Jaycar has stocked up especially this year but we may be out of stock later in March if you don't act quickly.

Cat. PB8810 WB-DN 100 holes $2.95
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Sennheiser — the name that means the ultimate in Headphone technology. These are high quality West German made units that are now available at a bargain basement price. As used in the 1st class section of the TAA Airbus and all Qantas 747's (1st class). Naturally the frequency response is a flat 20-20KHz. Impedance is 8 ohms.
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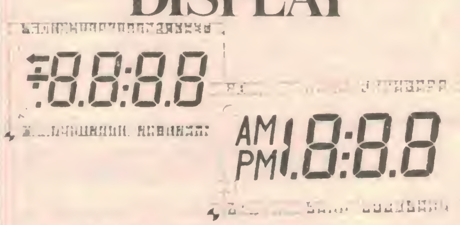

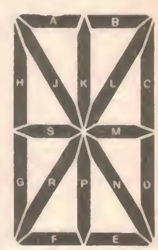

We have a small number of specific liquid crystal displays in stock. Each unit described below is supplied with a specific data sheet for that product as well as application notes re: drive requirements, multiplexing etc.

TYPE 5301A-51 This is a 3" high Starburst display which enables you to display all letters of the alphabet and 0-9 digits. Each segment is addressable. A large, high contrast display can be achieved.
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ONLY $10 EACH — Cat. ZM9010

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TYPE L-5640 — 51 & 54 This is basically identical to the H-5545 except that the digits are 0.6" high with a colon as well as the decimal point. Normally $22 each ZM9012(51) & ZM9013(54) $9.50 ea

TYPE L-563A-51 A 3½ digit 0.6" high 12 hour clock display with AM/PM annunciator and colon.
Normally $15 EACH — NOW ONLY $7 EACH Cat. ZM9014

FORUM

Conducted by Neville Williams

AM SIDEBANDS — here we go again!

Perhaps not too frequently, but with a certain inevitability, arguments arise, from time to time, about the existence (or otherwise) and the implications of side bands, in the context of amplitude modulation. They have been stirred up again by an article in our October '82 issue by Elmo V. Jansz and by a letter from D. Dutton on page 99 of our January issue.

Since then, we have had a number of letters and conversations which indicate that the confusion – and the arguments – live on.

The last major exchange on this subject occurred about eight years ago and provided the theme for "Forum" in the July 1975 issue.

The starting point, on that occasion, was a letter from G.E. of Tuart Hill, WA who expressed the conviction that, if one could suppress the sidebands from an AM transmission, one would still be left with a single-frequency, amplitude modulated carrier, receivable through a very sharply peaked tuning system. In a follow-up letter, he admitted to some faulty reasoning but went on to speculate whether it might still be possible to effect modulation in a way that would render it non-relient on sidebands.

By way of general commenting on G.E.'s letters, we summarised the usual textbook explanation of amplitude modulation, pointing out that, depending on their background, different groups of readers tended to visualise modulation in different ways.

We suggested that, despite the passion with which the different points of view are sometimes defended, they are quite capable of being reconciled.

Pursuing that point, we used a simple graphical illustration to show that any cyclic change in either the amplitude or the frequency of a sine wave (eg a carrier) must result in the generation of additional frequencies. With that point established, it became logical to accept the mathematical verdict as to what those frequencies were.

Our remarks in the July 1975 issue prompted a letter from Keith S. Imrie, at the time a Senior Lecturer with the Macquarie University in Sydney. He said:

"Convincing students of the reality of sidebands is, of course, of interest in universities, and one technique used could be of interest to you and your readers."

He went on to explain that instruments existed (at Macquarie University and elsewhere) which made it possible to synthesise modulated waveforms, using the precise frequency components that had been prediced by Fourier analysis. They could be exhibited on an oscilloscope screen or, in his case, drawn on a computerised plotter.

The letter was published in the November '75 issue, along with four plots showing pure AM, pure FM and a mix of AM and FM – all synthesised by the discreet choice and manipulation of signal sources representing individual sidebands.

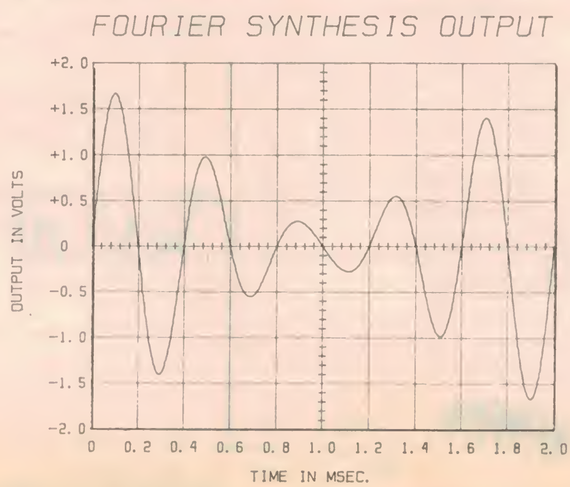
On learning that Elmo Jansz' article had been called into question, I turned back and read it, along with Mr Dutton's letter and the further correspondence. Having done so, I felt that many of the conceptual problems on this and other occasions could be re-packaged as two main questions:

- Do sidebands exist as separate, identifiable RF signals or are they really an integral part of what can so readily be displayed as an amplitude modulated carrier?
- Flowing from that quesion, should a diode detector be regarded as a mixer or a rectifier?

The short answer is that, in both instances, the alternatives are supportable.

As a starting point, it must surely be accepted that modulation sidebands can exist as separate, identifiable radio frequency emissions. They are just too accessible, too capable of manipulation for it to be otherwise.

- At an elementary level, back in 1975, we demonstrated graphically that modulation of an RF carrier had to produce additional frequencies.
- At a more advanced level, we pointed out that mathematicians were well able to quantify those frequencies.
- By way of verification, we published follow-up information indicating that the means existed to reverse the mathematical Fourier analysis and to synthesise classical modulation waveforms from the predicted components.
- At an everyday level, in communication systems and TV picture channels, radio frequency carriers and modulation



Explaining this diagram, Dr K. S. Imrie says that it depicts a carrier frequency of 2500Hz and a modulation frequency of 500Hz. He says: "The zero crossings occur where the carrier would have them (every 200μs)."

sidebands are variously attenuated or suppressed by the use of frequency selective circuits.

None of this would be possible if carrier and sidebands were not distinct and accessible.

And, of course, there remains the evidence of the radio frequency spectrum analyser which can show radio station carriers and sidebands disposed across the bands and behaving exactly as theory would predict.

Not only that, but, with a station that may be transmitting simple test tones, as they do on occasions, it can show the carrier rock-steady in position and amplitude, while the sidebands vary in height and position according to the amplitude and frequency of the test tone.

If it hasn't occurred to you already, one point is common to the preceding paragraphs: the thinking and the applications involve frequency selective circuits or presentation. To borrow a phrase from one of the correspondents, it is all centred in the "frequency domain".

I didn't use the term earlier, because I don't particularly like it. It is explicit to some, obscure to others and mere technical jargon to a great many more. But the summation of it is that when you have reason to gain access to, and manipulate individual frequency components or segments in a modulated carrier, they are separately accessible.

At this point, some readers may be tempted to smile happily, pick up their papers, switch off their minds and prepare to leave.

But don't go yet.

CONTOUR CONCEPT

Let's think about that classic proposition that, if the various RF components in a modulated signal are to exist separately, it would be necessary for active points in any circuit handling them to be at several different potentials simultaneously. Since this is a seeming impossibility, the concept of their separate existence must be invalid.

I referred to his matter back in '75 and, by sheer coincidence, mentioned it last month, in the context of audio hifi.

I made the point that, when an orchestra plays, the auditorium is filled with sound waves emanating from many separate instruments, and differing widely in amplitude frequency and phase. When these sound waves reach a microphone, the diaphragm will hopefully respond to them all but it clearly cannot be moving in different directions, or occupy more than one position, at any one instant.

What it does is to move to and fro, taking up positions at each successive instant, dictated by the algebraic sum of the sound pressure waves acting upon it.

In fact, as we pointed out, one could imagine a graph of the sound pressure resultant operating on the diaphragm, plotted against time. It would not be recognisable as discrete waveforms but would be in the form of a pressure contour.

A plot of diaphragm movement over the same time period could be expected to have a similar contour, as also would a similar plot of the electrical signal from the microphone. Indeed, all the way through an analog hifi system, we are dealing with a signal contour, ultimately producing a sound pressure contour which reaches the listener's eardrums.

The marvel of it is that, whether experienced in the original auditorium or in the domestic lounge room, our aural senses can resolve a sound pressure contour back into a pattern of recognisable component frequencies.

SIMILARLY FOR RF . . .

During the last few paragraphs (just in case you hadn't noticed) we have been envisaging signal voltages summed and plotted against time, rather than segregated and dispersed in terms of frequency. One could say that we have switched the basis of the discussion to the "time domain".

More to the point, there is a close parallel between the audio and RF situation.

In the space around us is a multitude of radio signals, made up of carrier/sideband packages from countless transmitters. They all start out separately but, at any given point in space, they tend to produce resultants which, at any instant, are the algebraic sum of all the radiation fields evident at that point.

Without being able to draw it, one could imagine a graph showing the RF signal voltage at the tip of your antenna lead-in, plotted against time. As in the audio case, there would be no question of the voltage having several values at the same time; the graph would be a contour of the algebraic sum of all the RF energy to which the antenna was exposed.

A spectrum analyser, connected to the antenna could extract from this summed voltage information about its component signals, sufficient to display at least the more prominent carriers and sideband packages. In so doing, it would confirm the same point as do our ears in the realm of audio:

Signals can, at the one time, be both summed and separable.

In an AM receiver, we have a somewhat different objective in view. The total summed signal from the antenna is passed through a number of tuned circuits which hopefully block all components other than the carrier and the

sidebands from the wanted station. What ultimately reaches the detector is still a summed signal but – ideally – it contains only those components which were originally radiated by the wanted station. And, because it is in summed form, there is no problem about the diode supposedly having to be at several potentials at once.

What does the summed signal look like?

Know something? Exactly like the illustration (Fig. 1c) in Elmo Jansz' original article and the CRO screen pattern on the second page. What's more, he has gone out of his way to distinguish it correctly by referring to it as the "modulated signal", the "composite modulated waveform" and the "modulated carrier waveform".

Frankly, none of these terms offend me and all of them imply something distinct from the original unmodulated sinusoidal carrier.

COMMENT ON COMMENT

Now what about the comment on the original article and the comments on the comment?

In D.D's letter, in the January issue, there is some element of setting up a target in order to shoot it down. He is obviously keen to emphasise that the original sine-wave carrier radiated from the transmitter is not altered by amplitude modulation; its power remains constant.

I wouldn't disagree with that, although I suspect that Elmo Jansz' "sin" in the eyes of D.D. was that he didn't say it in so many words. But neither did he say otherwise. In fact, the references and calculations in the latter part of the article imply that the carrier has a reference power (eg 60W) which is twice that of the total sideband power (eg 30W).

What appears in Fig. 1c of the original article, and in the accompanying CRO pattern, is variously described by Elmo Jansz as the "composite modulated waveform", the "modulated carrier waveform" and the "modulated signal". D.D. appears to regard it as something that is peculiar to a display which adds together the instantaneous value of the component signals.

On the contrary, I have suggested that the composite modulated waveform occurs in any situation where the component frequencies share a common medium. Certainly, if the bandpass of the preceding tuned circuits allows the sidebands to reach the diode detector, then the diode input signal, plotted against time, will have the appearance and the energy content as depicted graphically or on a CRO screen.

Once this is realised, it can be pursued relatively easily to a straightforward explanation (in the time domain!) of how a diode detector operates. Frankly, I regard it easier to cope with than the mixer concept which D.D. appears to prefer. However, for space reasons, we'll have to leave that aspect until a later issue.

In the meantime, I suggest you read a couple of letters, reproduced herewith. C.S. obviously disagrees with D. Dutton and, in so doing, adopts much the same approach as I have done in the foregoing article. If I had any reservation about his remarks, it would be his emphatic statement that "an AM signal IS a single fixed frequency carrier that varies in amplitude". He clarifies his meaning immediately afterwards but it is the kind of very positive assertion that, if misread, could produce the kind of misconception to which D.D. is objecting.

The other letter (M.M., Epping, NSW) starts off by pointing up the alternative approaches of time domain and frequency domain, but then runs headlong into a problem with the summing of multiple waveforms. Hopefully, my remarks earlier in the article will have helped sort that out. The latter part of M.M.'s letter is concerned mainly with diode detection but we'll have to hold that subject over.

What other readers say:

I read with interest Elmo V. Jansz' article on AM (Oct '82) and D. Dutton's Letter to the Editor (Jan '83).

There are two different ways of describing a signal mathermatically: (a) in the time domain and (b) in the frequency domain.

The time domain gives us the more direct description of reality — eg, a graph of how some voltage varies with time. The frequency domain is based on Fourier's theorem which says basically that any periodic waveform can be expressed as the sum of a number of sine waves (the frequency components).

Fourier's theorem does not say that the components actually exist separately. To say that they do would be self-contradictory, since this would imply that the voltage at some point in the circuit at a given instant of time would have several different values.

Although D.D. would seem to disagree, I believe that one can give a valid time-domain description of AM. One must, however, be very careful of the word "carrier". D.D. quite rightly points out that the carrier (the component of frequency fc in Fig. 2 of the article) does not vary. However, in the sixth paragraph of his letter, he says that it appears to vary on an oscilloscope screen because "the oscilloscope receives three different frequencies and algebraically adds them together."

I contend that:

(a) The oscilloscope does not do any adding because what it receives is already a single signal.

(b) What is seen on the screen is not a carrier; it is the modulated signal.

The main thing I object to in Elmo Jansz' description is that, in par. 7, he should have said that the carrier (or whatever we call this RF signal) is varied in accordance with the instantaneous value (not amplitude) of the audio signal.

I also have a disagreement with D.D.'s comments on detection. (Here the writer expresses his ideas about the mixer concept. Editor)

The traditional explanation (attacked by D.D.) which says that the capacitor fills in the gaps between the carrier peaks is a time-domain explanation of the same process and is also valid. M.M. (Epping, NSW).

Alternative approaches

I read with interest the letter from D. Dutton in the January issue re amplitude modulation. I feel that he is mistaken, not in his understanding of AM demodulation as non-linear mixing of sidebands and carrier, but in his rejection of the rectification theory.

An AM signal IS a single fixed frequency carrier that varies in amplitude. Examination on a CRO shows that all cycles have the same period; hence the same frequency. However, it is not a sine wave. Like all complex repetitive waves, it can be broken into (or synthesised from) a number of sine waves, in this case the familiar carrier and two sidebands.

What we have is two ways of describing the same thing.

Diode detectors can be described in two ways: as rectifiers or as non-linear mixers. Both are legitimate.

If I was fault-finding a basic detector, the first thing I would look for is a DC voltage — clearly a rectifier-based thought.

If I was designing the bandpass of the IF strip, I would consider the sidebands. While this could be done with calculus based on the dv/dt (off the CRO) to do so would be a waste of time.

As I said earlier, the appropriate approach depends on what you are doing. C.S. (Radio Trade Teacher, RMIT).

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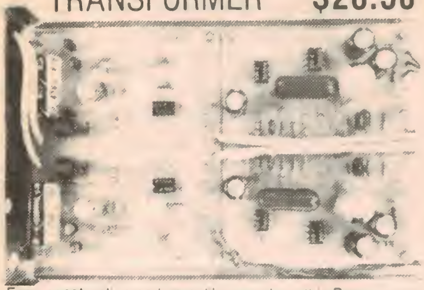

Easy construction and versatile operation this Preamp was for coupling with the 300W "Brute" Power Amp. **ETI 467 July 80**

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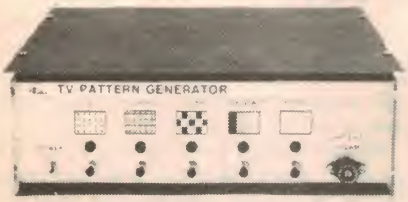

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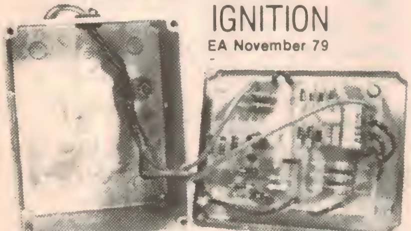

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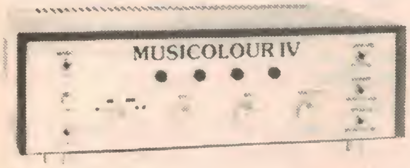

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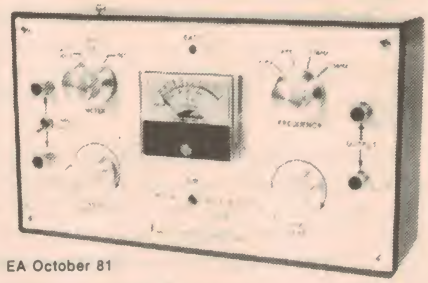

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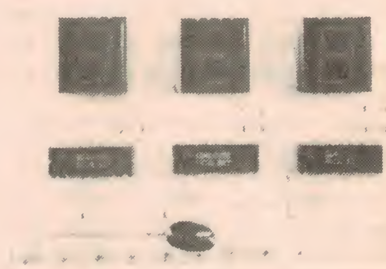

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COMPACT disc DIGITAL AUDIO

First entry from Sanyo into the Australian CD player market is likely to be the model pictured at left and designated OTTO DAD 03. It measures 335(W)x140(H)x180(D)mm and features what Sanyo claim to be an exclusive 3-beam laser diode.

What's inside a CD player?

Having discussed last month, in broad terms, the nature and the likely impact on the hifi market of the compact disc system, we take a closer look, this month, at the equipment itself. First off, let's look at the actual CD players — their external controls and their internal "works".

by NEVILLE WILLIAMS

In discussing compact disc equipment, it is difficult to know where to start.

- The discs themselves are physically quite different to anything we have encountered in 100 years of gramophone/phonograph technology. A separate article is called for, dealing with their recording and production.

- The signal information, in digital form and intended to be read back by a laser, has nothing in common with the traditional analog system. A complete article will be required even to outline digital encoding and decoding — and probably several more articles before one can really come to terms with it.

- The compact player has very little in common with even the most modern phono deck. It needs more complicated electronics to control the disc motor and signal — pick-up system but, beyond that, includes special circuitry to transform the digital signal from the disc into analog form, suitable to feed into an existing hifi amplifier system.

In succeeding issues, we propose to talk about these things in the reverse order to the way we have listed them above. First, let's concentrate on the compact disc players, which are just now beginning to appear on the local market.

Fortunately for those who are not technically inclined, a compact disc player makes no greater demands on the end-user than a conventional phono deck. There is a power lead for connection to the AC mains and a twin signal lead for connection to the Left and Right AUX (Auxiliary) inputs of the stereo amplifier. Pop the disc into the appropriate slot or drawer, press the PLAY button, then settle back and listen to the music.

Closer inspection of the facilities may reveal buttons which allow the user to select individual tracks, play tracks in a nominated order, skip forward, skip back, or even set up a timer for slumber or wake-up music. But, these days, such facilities are commonplace in domestic audio and video equipment and their use is a matter of personal choice.

If one does want to come to grips with the technology of a compact disc player, it is necessary to start with at least a few basic facts about the compact disc itself, as now standardised within the hifi industry.

It has a diameter of 120mm, a thickness of 1.2mm and a centre hole diameter of 15mm. On one side is a label carrying the track titles, etc, while the sound track is on the other side, protected by a clear plastic film but able to be read by a laser light beam. The sound track takes the form of a long spiral of microscopic pits starting from an inner diameter of 50mm and working outwards at a pitch of 1.6μm to an outer diameter of 116mm.

(While the single-sided format is logical and convenient for most purposes, double-sided discs would be feasible, but labelling would be a problem.)

Unlike a normal phono record, the compact disc is not designed to spin at a constant rotational speed (eg 33, 45, 78rpm). Instead, it is intended to be played at a constant groove speed lying within the range 1.2 to 1.4 metres per second.

Play starts from the inside with the disc spinning at about 500rpm, slowing to about 200rpm as the laser reading head approaches the outer track. Rotation is counter-clockwise, when viewing the read-out surface, while playing time is a nominal 60 minutes, or 74 minutes as the absolute maximum.

The apparent vagueness about rotational speed ("from about . . . to about . . .") and track lineal speed (1.2 to 1.4m/sec) is not the result of any

lack of standardisation. It is due to the fact that the real standard is the rate of flow of the data bits from the disc into the data processing system of the player.

So, depending on the diameter of the spiral being read, and irrespective of slight eccentricities, or slight variations in the packing density of the data bits in the spiral, the speed of the data bits past the read head must be exactly right. The motor speed is electronically controlled with that objective in view.

Herein lies the first major difference between a compact disc player and a traditional phono deck. In the latter case, enormous effort is concentrated into achieving a sedate but constant rotating speed — 33½ or 45rpm — in the knowled that any periodic variation therefrom is almost certain to produce audible wow and flutter in the recovered sound.

In the CD player, the motor operates in a much higher speed range, diminishing in a very precisely controlled manner from around 500rpm to 200rpm. While it is heavily dependent on external electronic circuitry for control, the motor must be of suitable design — typically a direct drive DC type with in-built speed sensing and Hall-Effect electronic commutation. The motor and turntable need to be an intrinsically compact package with the smallest possible tendency to spindle flexing, etc.

We shall have more to say later about motor speed control.

Fig. 1, repeated from our last issue, is an exploded diagram which shows — typically — how the signal is derived from the compact disc — a very different process from what we have known to date.

Instead of a jewelled stylus riding in a physical groove in the upper surface of a large disc, a tiny beam of light from a solid-state laser is focussed on to the reflective underside of a compact (12cm) disc — or on its rear side when played in a vertical-loading player. An optical system "reads" the signal encoded in the surface without ever touching it.

Reterring to Fig. 1, the "light" source is a solid-state laser diode for which the optical output has been standardised at a wavelength of 780nm (nanometres) or 7800A (Angstrom) in the infrared portion of the spectrum. The reason for nominating a specific wavelength (with a small tolerance) is that it allows the optics of the system to include elements and dimensions which rely for their efficiency on wavelength-related dimensions.

A laser is necessary because it offers the only practical way to provide a "coherent" beam — composed of a single frequency — and of adequate intensity.

The beam from the laser diode passes through a collimator lens which helps to ensure that the rays will remain completely parallel on their journey through the optical system.

Also in the path of the beam is an optical grating, which has an incidental function, to be described later. Next, it enters a polarised filter and prism/splitter, commonly combined in one unit and referrred to as a PBS (polarised beam splitter).

Emerging from the PBS, the beam, now in polarised form, passes through a quarter-wave plate (¼-wave at the wavelength of the laser) which rotates the polarity by 45 degrees.

Next comes the objective lens, which brings the beam towards — but not to — focus at the surface of the protective plastic film. The film has a specified thickness and a specified refractive index of 1.5, so that it can form part of the optics which finally brings the beam to focus at the internal reflective signal surface.

To quote a few relevant figures, the diameter of the beam where it strikes the outer protectitve film may typically be 0.8mm but, at the plane where it strikes the signal surface, the spot

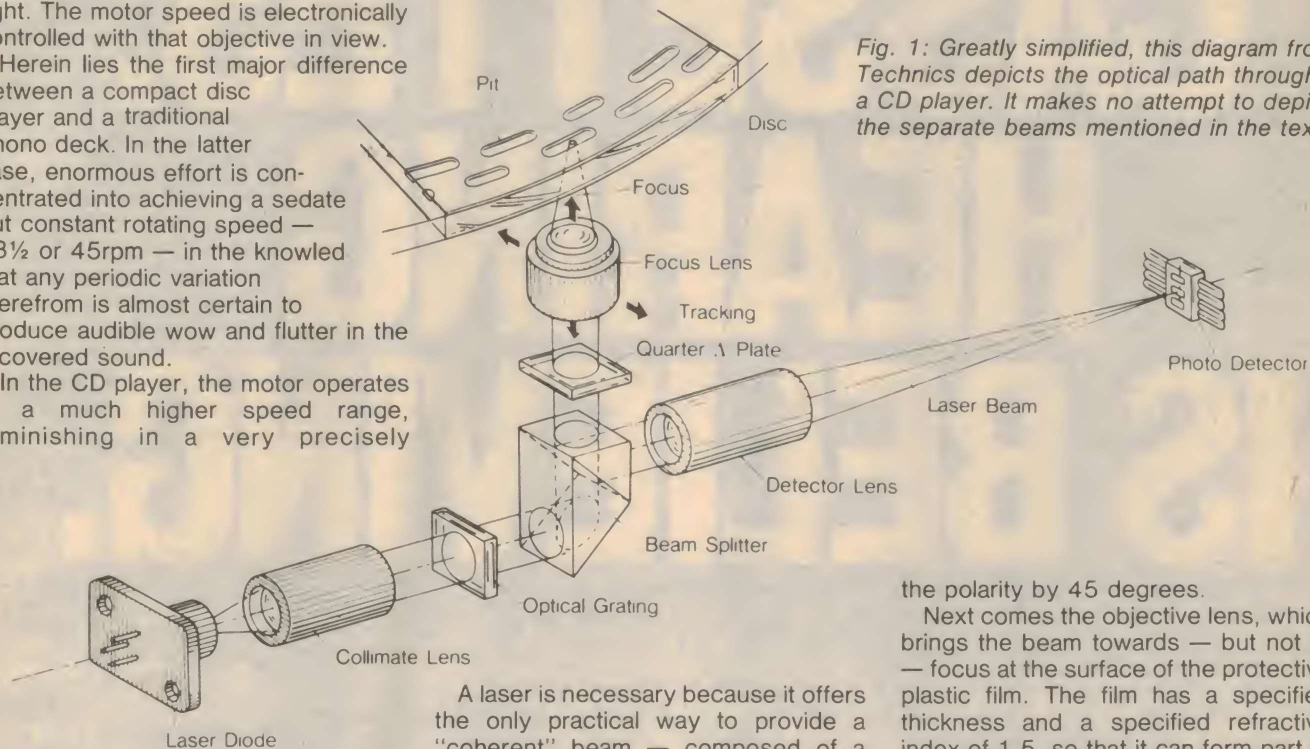

Fig. 1: Greatly simplified, this diagram from Technics depicts the optical path through a CD player. It makes no attempt to depict the separate beams mentioned in the text.

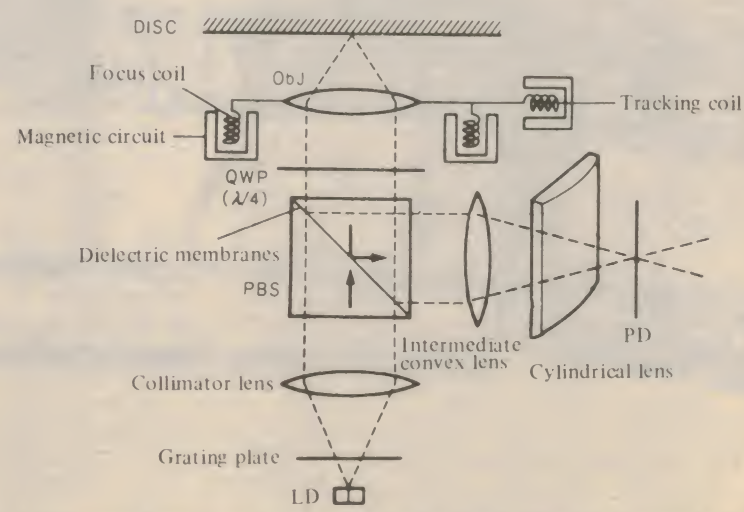

Fig. 2: Even more simplified, this diagram comes from Sony literature. It shows the grating plate adjacent to the laser but does not clarify its role as the source of the multiple beams for signal sensing and tracking control.

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What's inside a CD player?

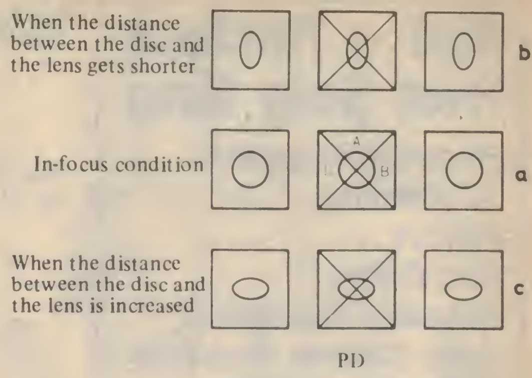

Fig. 3 (right): When the system is in correct focus, the beam illuminates equally all four quadrants of the signal photo detector (centre). Out of focus, the beam spot becomes oval (top, bottom).

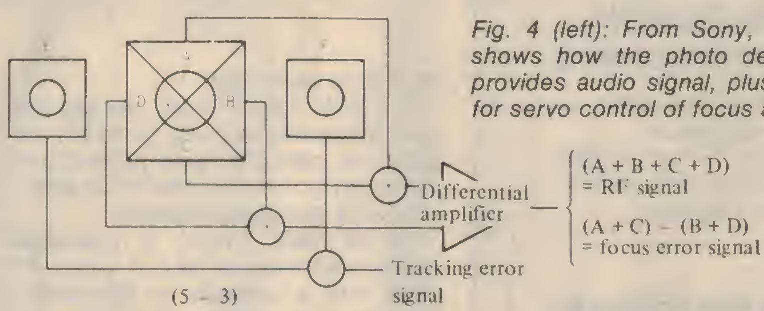

Fig. 4 (left): From Sony, this diagram shows how the photo detector array provides audio signal, plus information for servo control of focus and tracking.

diameter may typically be 1.7μm, a reduction in area of about 200,000 times. The point of this is that the shadow of a dust particle or a scratch on the outer protective surface has to be quite large before it causes an error in signal readout. In practice, anything less than 0.5mm across is unlikely to be significant.

But, to get back to Fig. 1: when the beam strikes the mirrored inner surface of the disc, it is reflected back through the objective lens to the quarter-wave plate. Here the beam undergoes a further 45-degree phase rotation so that, by the time it reaches the polarised beam splitter again, it has undergone a full 90-degree phase shift.

This being the case, it is diverted by the splitter optics into a separate lens and thence to the photo detector, substantially free from any direct illumination from the laser diode. (By way of interest, we have included Fig. 2, from Sony literature, which presents much the same information.)

How is it modulated?

A key question remains unanswered: if the bottom of the microscopic pits is made reflective along with the rest of the mirror surface, how can the pits possibly modulate the reflected light beam?

In fact, the answer provides one of the delicious subtleties of the optical disc system.

First off, the pit width is standardised at 0.5μm, so that it is straddled by the 1.7μm beam. Therefore about half the reflected light comes from the normal mirrored surface and the other half from the bottom of the pit.

But the pit depth is deliberately standardised at about 0.11μm (110nm) approximating one quarter-wavelength of the laser light in a medium (the clear plastic coating) with a refractive index of 1.5. In travelling the additional distance of one half-wavelength (into and out of the pit) the reflected light emerges out of phase with the light reflected from the adjacent surface. Cancellation occurs, with the result that the reflected light drops toward zero each time a pit passes under the scanning spot.

Depending on the varying length of the pits, the photo detector receives a rapid sequence of longer or shorter, "light" or "dark" pulses, which it is the business of the associated circuitry to recognise and decode. But that is another story, as we indicated earlier.

While the foregoing adds up to logical modern technology, the critical nature of the dimensions involved are mind-boggling. But there are more to come:

The pitch of the spiral track on the disc is 1.6μm, or just over three times the width of the pits themselves. On this basis, in a signal track space of 33mm between the minimum and maximum recording radii, there is room to lay 20,000 side-by-side tracks.

To establish some kind of mental reference, this means that about 60 optical tracks can be laid in the space occupied by one single groove of a conventional LP analog disc, or 30 optical tracks in the width of a human hair!

It is virtually self-evident that no practical mechanical system could itself track such finely spaced grooves radially, nor ensure critical focus at all times at the reflective signal surface. Add to this the problem that the discs have to be mass-produced at an affordable price and that, inevitably, they will introduce their own dimensional vagaries.

In practice, the manufacturers of both players and discs strive for the highest possible mechanical standards, consistent with cost, but then rely on electronic servo control systems to achieve the required end result.

Servo control systems

The degree of such reliance is very high. In the matter of focus, only about 1% of the possible mechanical displacement can be accommodated by the focal depth of the optics; the other 99% has to be compensated by servo-controlled movement of the focus lens itself.

Invariably, then, compact disc players use elaborate electronic servo systems to maintain tracking and focus, as well as lineal groove speed, as mentioned earlier.

While the optics, electronics and electro-mechanism of individual players will inevitably vary from one manufacturer to another, and evolve with time, a couple of specific examples will serve to illustrate the principles. And here we turn back to Figs. 1 and 2.

The optical diffraction grating, bypassed in the earlier discussion, is designed to split the single beam from the laser into three separate beams. They are spaced closely enough to pass through the entire optical system together, but not so close as to prevent the main centre beam from, alone, deriving signal information from the pits,

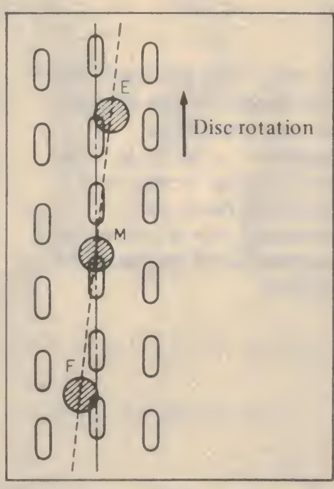

Fig. 5: Three beams from the one laser, straddling the spiral of pits, read the signal and sense both focus and tracking. (Diagram by Sony.)

What's inside a CD player?

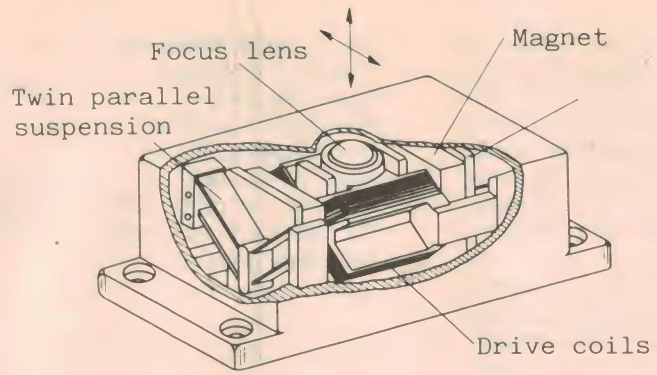

Fig. 6: This sketch from the Technics SL-P10 literature depicts the servo assembly which controls focus and tracking. Its derivation from electromagnetic transducers is apparent.

as already described.

This main central beam can also be used to sense focus and, to do this, an additional cylindrical lens element (not shown in Fig. 1) is included in the optics in front of the photo detector.

By its very nature, a cylindrical element will tend to distort a circular beam into a vertically or horizontally inclined oval shape, depending on where it is placed in the optical path. For focus control, the optics are logically positioned so that an intermediate condition — a round spot — falls on the photo detector when the whole system is in perfect focus.

This is illustrated in Fig. 3a, which also shows that the photo detector (centre) has been sub-divided into four quadrants, each served by a separate sensing element: A, B, C and D. For sensing the main signal off the disc, the quadrants operate in parallel. For focussing purposes, their relative output is examined by separate circuitry, sensitive to the area of each quadrant which is illuminated.

If the disc is slightly closer to the focus lens than it should be, the spot on the photo detector array may be as illustrated in Fig. 3b, or as in Fig. 3c for the opposite situation.

The resultant of signals A+C and B+D can be interpreted as a focus error signal and this can be applied to a differential amplifier controlling the position of the lens (Fig. 3). By maintaining the error signal at near zero, the system holds the system in focus.

The additional spots and sensors depicted on either side of the photo detector in Fig. 3 play no part in either signal sensing or focus control. Their prime function is to control tracking.

The optics are arranged as illustrated in Fig. 5 such that, when the signal detection spot is centred on the track being scanned, the other two are just

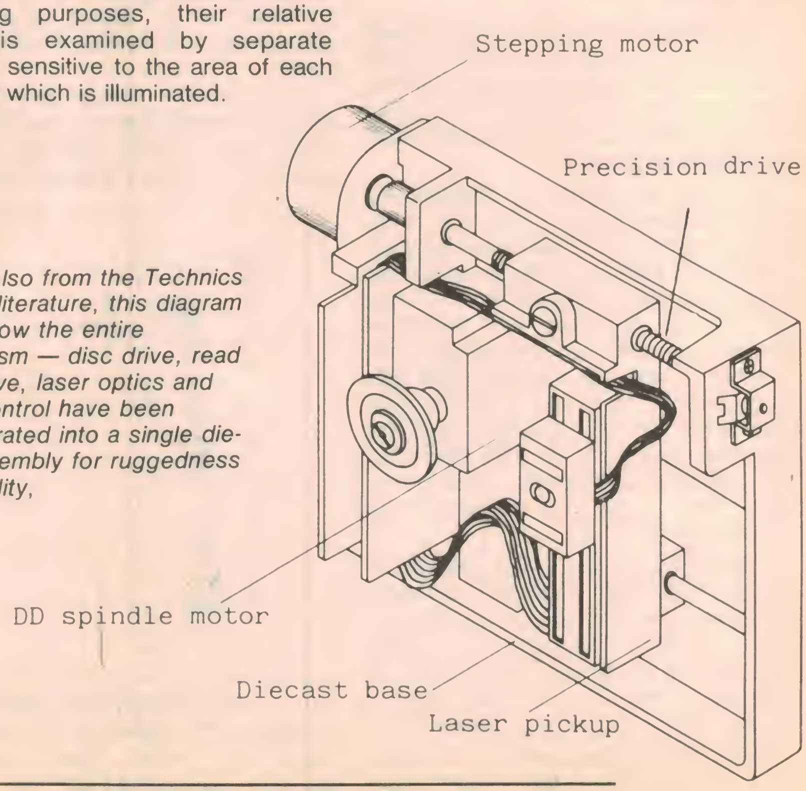

Fig. 7: Also from the Technics SL-P10 literature, this diagram shows how the entire mechanism — disc drive, read head drive, laser optics and servo control have been concentrated into a single die-cast assembly for ruggedness and rigidity,

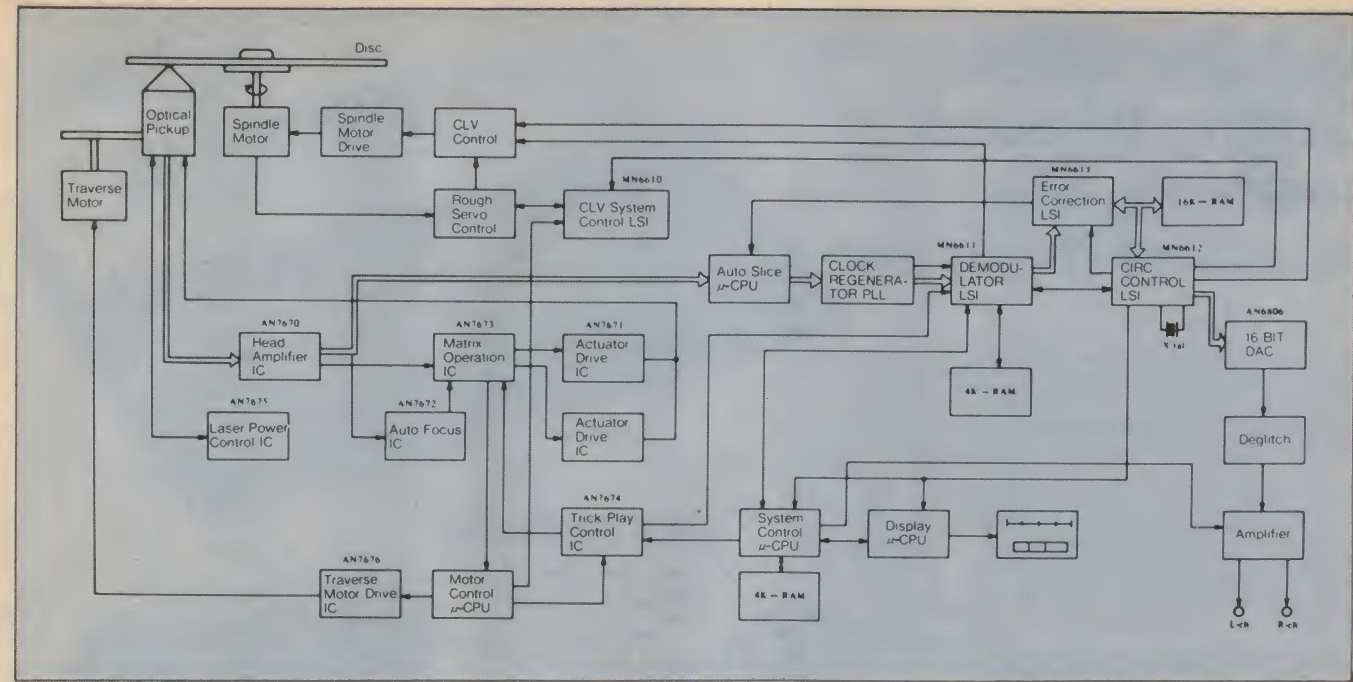

Fig. 8: A CD player contains far more electronics than a phono disc deck but the signal does emerge fully processed and ready to feed into the amplifier "AUX" input. It should also be of much higher technical quality.

overlapping the pits but are mainly scanning the non-pit strip to either side. In this condition of perfect tracking, the average intensity of the reflected light from the two tracking control spots is balanced.

If the tracking starts to wander, the balance is disturbed and an error signal is generated which, in the short term, can be used to tilt the lens to follow an eccentric track and, in the longer term, to influence the transport of the scanning head as a whole.

It may seem rather startling that a lens system can be focussed or tilted at a rate of 500Hz or more, to cope with slight eccentricities or undulations of a disc revolving at that speed. However, extensive technology derived from modern transducer manufacture (loudspeakers, headphones, phono cartridges, etc) is reflected in the electronically controlled lens mounts being used. Fig. 6 is a sketch of a typical unit, while Fig. 7 shows a complete disc drive and optical scanning module.

The disc drive motor and its precision electronic drive, plus the diode laser and its complex, electronically controlled optics, constitute the basic structure of a compact disc player — in some ways the counterpart of the turntable drive and pickup system of a conventional LP player.

But whereas an LP player involves, at most, only a small amount of internal electronics, a CD player is packed tight with high technology circuitry, not only to do with the servo systems already discussed, but necessary for the processing and decoding of the digital signal off disc. It would be safe to say that it is only practical because of the availability of a variety of advanced integrated circuits.

Depends on ICs

By way of illustration, Fig. 8 shows in block schematic form, the internal workings of the Technics SL-P10 compact disc player. It can be taken to be typical of the technology available to the industry and used in various forms by all the major manufacturers.

Commenting on the design, Technics say that 95% of the circuitry is concentrated in and around ICs (integrated circuits) and LSIs (large-scale integrated circuits), of which no less than 12 were developed expressly for the CD player. Four of the LSIs each contain the equivalent of 50,000 transistors and are examples of the most advanced LSI technology in current production.

Three LSIs are used in the signal processing circuitry for demodulation and error correction, and one in the drive motor/time base servo system. Seven ICs are involved in the laser/signal pick up control system, while another is at the heart of the 16-bit digital/analog converter.

A detailed analysis of Fig. 8 would take up more time and space than is available here.

In brief, however, the disc drive and motor is shown towards the top left corner, with three levels of feedback into the motor control system: a "rough" control from the motor's internal sensing, one from the clock/demodulator level, and one from the final digital signal, involving error correction and RAM Storage, and just before digital/analog decoding.

Also at the top left is the motor drive for the laser read head transport. Control for this motor comes via an IC and a microprocessor function and includes differential sensing from the tracking beam as well as instructions from the "trick play" controls on the front panel — Pause, Skip, Repeat, etc.

Focus and tracking

As we have already seen, there are two "motors" — or electro-mechanical drives — to do with the laser optical system, one to provide focus and the other tracking. The actuator blocks for these functions are just left of centre in the diagram, being fed with signals via the "Head Amplifier" IC.

From the head amplifier, the main signal path, depicted as a double arrow, flows into the digital processing system (right of centre in the diagram). Here, it is compared with the "clock" crystal for timing and control and is subjected to error checking and temporary storage before being "clocked out" into the digital/analog converter and thence into the twin channel analog amplifier to the output terminals.

As we said earlier, the digital processing is likely to involve not one but several articles to explain, while even the matter of user controls and programming warrants an article in itself.

But, for the present issue, enough is enough!

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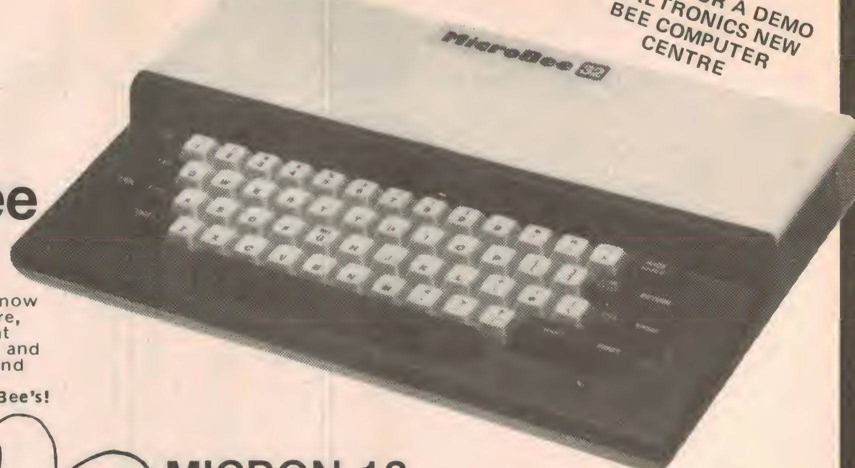

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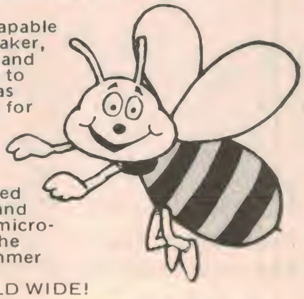

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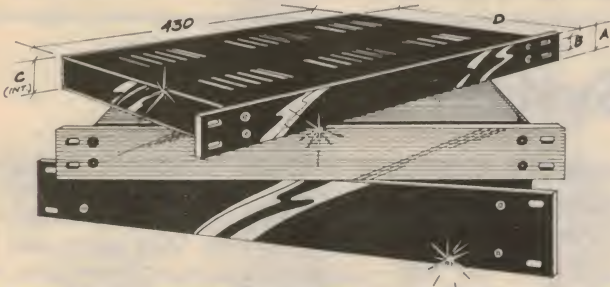

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Hifi Review

Meridian M3 InterActive System

Most high fidelity equipment is fairly bulky and usually has a lot of controls. Meridian hifi equipment is just the opposite; it has few controls and is surprisingly compact. Part of the secret is that the loudspeakers incorporate their own power amplifiers, as we found when we reviewed the Boothroyd Stuart Meridian M3 InterActive System.

The basic Meridian M3 InterActive System starts with a pair of M3 active loudspeaker systems which are normally teamed with a Meridian 101 Control Unit. To this may be added the Meridian FM Tuner which is not featured in this review.

The M3 active loudspeaker systems must have one of the smallest cubic capacities of any loudspeaker system on the market. The enclosure measures just 365mm high by 170mm wide by 300mm deep. 80mm of that depth is taken up by the two power amplifiers, a 70 watt unit driving the bass and a 35 watt unit for the tweeter. This adds up to a fairly weighty package at 12kg.

In keeping with the small size of the loudspeakers, the Meridian 101 Control Unit is very small, measuring 140mm wide, 52mm high and 315mm deep and weighing about 1.8kg. This unit is very spartan in appearance, with just three lever switches and one knob. Closer examination reveals that this is a concentric control with volume at the front and balance behind. The balance function is not labelled by the way.

While the weight of the control unit may not seem unusual at 1.8kg the outer case is exceptionally strong and rigid which no doubt helps an image of quality as well as preventing any damage should you accidentally step on it.

Boothroyd-Stuart assume that your main sound source will be discs for there is no switch position to indicate that selection. Pushing one of the three levers down selects either Radio or Tape while the third lever selects the mono mode. So if you are one of those hifi enthusiasts who believe that tone controls are unnecessary and cause distortion you could probably be happy with the Meridian 101. It does not have any facilities for tape dubbing or headphone listening either, which may be a little harder to accept.

Mains power for the two M3 active loudspeaker systems is supplied from the 101 Control unit via a switched and shuttered three-pin IEC socket. Tuner and Tape inputs and the preamplifier output are via DIN sockets but a pair of gold-plated RCA line sockets have been fitted for connection of the phono cartridge. The phono cartridge can be either a moving coil or moving magnet type but once you have decided you cannot change back and forth at will.

This is because most of the active circuitry inside the 101 control unit is contained in three small plug-in units. One of these plug-in modules performs the phono preamplification and equalisation and different modules are specified depending on your choice of cartridge type. While it is fairly easy to slide the control unit out of its case to change modules, quick changes between cartridges are obviously not possible.

While we could not examine the components inside the three modules, the circuitry would appear to be fairly conventional and is based partly on integrated circuits. Power for the control unit is supplied by a smal toroid transformer to achieve a low level of flux leakage. Two three-terminal regulators and a standard rectifier and filter circuit are used to develop balanced positive and negative 15V supplies for the circuitry. No one could accuse the makers of adopting a complicated or esoteric approach.

If desired the loudspeakers can be placed quite a long way from the 101 control unit (and turntable) by virtue of the seven-metre long power and signal leads supplied. The 101 is quite able to drive long signal leads because it has a 600Ω output.

Power connections to the M3 loudspeakers are via an IEC three-pin plug while the signal connection can be made to one of two DIN sockets. One of

The Meridian M3 is a small bass-reflex system with active crossover, time alignment and two power amplifiers all enclosed in the small cabinet.

the sockets provides a slight bass cut and a corresponding slight increase in power handling when the unit is shelf mounted rather than on the proprietary metal stands.

These stands have a large footplate which appears to be made out of a phenolic compound (could it be Bakelite?) and a folded steel column which tilts the speaker back slightly and jacks it up off the floor by about 45cm so that the speaker is correctly positioned for the average listener when seated.

While we regard the concept of the stands as excellent, as it sets the speakers in the optimum listening position, the stands themselves leave a lot to be desired. For a start, the relatively heavy weight of the speaker cabinets makes them decidedly unstable and easily knocked over. They would be a hazard if there were young and lively children in the household.

Second, because the columns are made out of light gauge steel, they are quite resonant and will ring and rattle markedly when tapped. This rather detracts from the good work Boothroyd-Stuart have put into the enclosures which are quite acoustically "dead" by themselves but ring when attached to the stands. It is a relatively simple matter to stuff foam rubber into the inside of the columns to quieten them and we are surprised that this is not rigidly specified since the instructions supplied with the speakers enjoin the user against placing the speakers near any furniture or objects which may resonate. We feel that the stands should be made entirely of heavy steel plate, say 10mm thick, which would give adequate stability and render them non-resonant.

More impressive are the power amplifiers of the M3 system. The whole rear panel of the enclose of the M3 can be detached by removing four screws. With the disconnection of a five-way plug, the entire electronics of the system can be removed from the cabinet. The five-way plug connects the audio amplifiers to the tweeter and bass drivers as well as connecting power to an incandescent pilot lamp which shines discreetly through a bezel in the grille cloth frame.

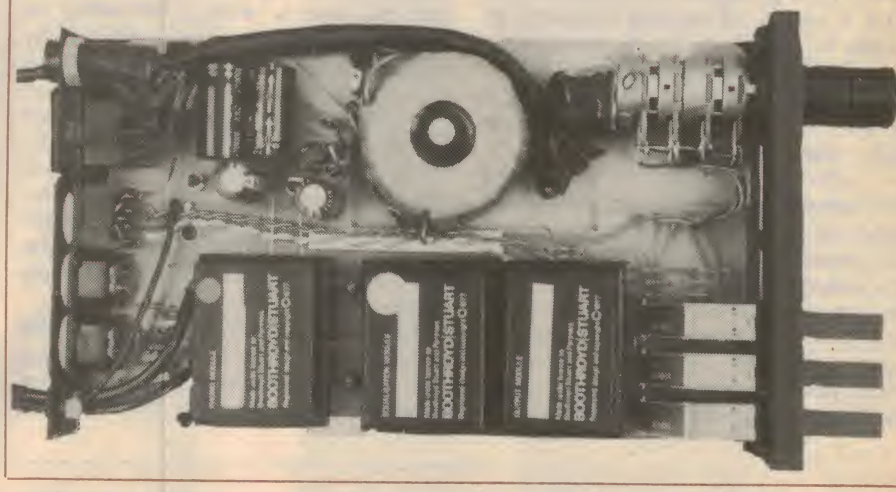
The M3 power amplifiers use a large toroidal transformer which feeds a bridge rectifier and two 6800μF/63VW filter capacitors which feed both power amplifiers and the active filter circuitry, the latter via three-terminal regulators. The active filters use the low noise op amps, NE5532, but the rest of the amplifier circuitry is discrete with MJ15003/4 complementary bipolar transistors in the output stages.

Boothroyd-Stuart make great emphasis of the fact that their amplifiers use shunt feedback rather than the more commonly used series feedback and cite a number of advantages, one of them being that the feedback signal is thus a current signal and thus the power amplifiers will be immune to spurious voltage changes in the power supply which is common to both amplifiers.

We really could not see the point of this heavy emphasis as it seemed to be an attempt to justify the relatively simple but perfectly adequate common power supply. And we are certainly in favour of simple power supplies!

Boothroyd-Stuart also claim substantial advantages for the electronic crossover system employed in the M3 as opposed to conventional passive crossover networks. One of the main advantages is that the crossover rolloffs can be much steeper than in a passive design and thus the tweeter can be used at much lower frequencies than would oitherwise be the case. They claim that this enables them to eliminate the need for a midrange driver while allowing far greater detail and less colouration than would be produced with a midrange unit. Thus, the Meridian M3 uses 24dB/octave crossover slopes. Even though one could argue that it is entirely possible to produce a passive crossover network, it would involve a loss of efficiency and present greater difficulties in matching the two drivers, especially if the tweeter happens to be less sensitive than the woofer.

These are external and internal views of the Meridian 101B Control Unit.



Time delay compensation, so that the signal from the tweeter is in-phase with that of the woofer, is applied in the Meridian M3. When time-delay compensation (or time-alignment as it is alternatively called) first became a feature of loud-speaker design, it was achieved by physically "stepping back" the tweeter which led to weirdly shaped and expensive-to-construct enclosures.

This is where the active crossover network for the M3 also scores, because it incorporates a 75μs delay for the tweeter signals, to achieve time alignment without a stepped enclosure.

While at first sight the enclosure of the M3 is a relatively simple structure, closer examination reveals that a great deal of work has gone into it. For example, the black-painted baffle is actually a precisely machine section of synthetic wood which is much more dense and more non-resonant than the particle boards conventionally used.

The tweeter is a soft dome unit with a large circular metal mounting plate and a nominal diameter of about 32mm. The woofer is bextrene cone unit with a rubber roll surround and nominal diameter of 110mm. The effective cone diameter would be about 90mm.

MERIDIAN M3 INTERACTIVE LOUDSPEAKERS

Just below the woofer are two ports about 25mm in diameter and fitted with an "acoustic filter" which is apparently made of lengths of plastic tubing. Its purpose is claimed to "streamline the flow of air at the low operating frequency while attenuating any midrange signals to maintain low colouration". In practice, we assume that this means that the filter reduces audible "chuffing" effects from the relatively small port.

The enclosure itself is made from 20mm thick Birch plywood with plenty of internal bracing and damping to ensure a "dead" box, as noted above.

Installation of the system is straightforward and presented no problems. We used a variety of moving magnet cartridges for our tests. No hum problems were encountered which is good but we did feel that the residual noise of the system, with the stylus off the disc, was higher than for most systems.

A subsequent measurement proved this impression right as the unweighted signal-to-noise ratio of the phono input with respect to a 5mV/1kHz input signal was around 54dB. This is to be expected from a preamplifier which uses shunt feedback (and hence a 50kΩ series input resistor). By comparison, conventional phono preamplifiers using series feedback usually turn in S/N ratio figures of 75dB unweighted, or better.

The S/N ratio of 54dB for the Meridian system means, in practice, that with the volume set to normal listening levels the average listener will be aware of hiss from the speakers when no record is playing.

We found that the rear panels of the M3 loudspeakers became warm to the touch after 15 minutes or so, whether or not a record was playing. This is of no cause for concern although Boothroyd-Stuart do warn against leaving the system on for long periods unattended.

If one had to describe the sound of the M3 system in a word, that word would have to be "clarity". One has the impression that one is hearing everything on the record which is being produced by the cartridge and to this extent, the Meridian is very revealing of any harshness in the cartridge, any mistracking and any surface noise, tape hiss, clicks or pops.

This means that some records which sound quite acceptable on a less demanding system may be judged unlistenable on the Meridian. By the same token, the best digital records sound extremely good.

Overall, one would have to judge the frequency response of the M3 as being very smooth, without any untoward peaks or dips. We did notice some "hardness" or "harshness" in the upper midrange but this trait could probably just as easily have been laid on any of the cartridges used in the listening sessions — the characteristic is fairly subtle.

Bass rendition is very "tight" without any trace of boom. This would no doubt lead many people to reach for the bass control to peg it up a notch or two but this cannot be done with the Meridian. What you hear is what you get and there is little you can do to change it. Even so, on some records, particularly those featuring pipe organ, we felt that the lower bass response was just a little light on.

Power handling is adequate without being startling. In fact, if you are wont to turn the wick up, the amplifier protection circuits may cut in briefly . . . leading to periods of silence. Certainly, it is evident that the M3 loudspeakers would be embarrassed if bass boost was available and freely used.

So how do we sum up the Meridian M3 system. Certainly, it requires a firm commitment from the buyer in terms of its sound quality and power handling. If you are a hard rock fan then you had probably better look elsewhere. And if you like tone controls (and dare we say it, loudness boost), the Meridian is not for you. But if you have a firm conviction that a high quality sound system should

(Continued on page 149)

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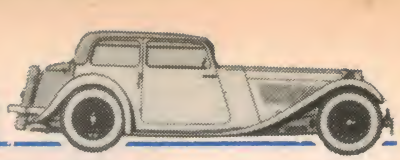


Analog fuel consumption meter

Featuring a 20-LED bar graph display, this unique circuit displays instantaneous fuel consumption in both litres/100km and litres/h. The principle is simple: the more LEDs that light up, the more it's costing you. Build it for your car and save petrol!

by JEFF SKEEN & GREG SWAIN

Whether you own a traditional Australian six-cylinder car or a more economical four-cylinder car, the price of petrol has become a significant factor in everyday motoring. Who would have thought, just a few years ago, that motorists in the "lucky country" would have to pay 45c/litre (or more) for petrol? Motorists in New Zealand are even worse off – the price there is currently about 70c/litre!.

With petrol prices like these, it makes good sense to strive for the lowest possible fuel consumption. Fairly obviously, the fuel consumption that you get from your car will depend largely on your driving habits. The driver who accelerates away from traffic lights like a startled rabbit, who brakes heavily, or who drives at excessive speed needlessly wastes petrol.

In fact, two different drivers can obtain widely different fuel consumption figures for the same car! It's all a matter of driver technique. The trick is not to emulate Starsky and Hutch, but to drive as smoothly as possible. The good driver carefully reads the traffic ahead and avoids heavy acceleration and braking as much as possible.

The role of the driver in obtaining good fuel economy is well recognised by car makers, several of whom now fit economy gauges as standard equipment. A typical device is the vaccum gauge as fitted to the Holden Commodore, which monitors inlet manifold pressure. The idea here is that the less the throttle is opened, the lower the manifold pressure and the lower the fuel consumption.

In practice, a vacuum gauge is a fairly useless device, since the only information it gives the driver is a rough indication of how wide the throttle is opened. It doesn't tell him what he really wants to know – ie, the instantaneous fuel consumption – so its use as an economy aid is rather limited.

That's where out new Fuel Consumption Meter comes in. It uses eleven readily available integrated circuits and works in conjunction with fuel flow and distance sensors to give the driver a bar graph readout of instantaneous fuel consumption in either litres/100km (l/100km) or litres/hour (l/h). The device is easy to build and install, and its compact size (129x131x40mm) ensures that it can be fitted to the dashboard of any model car.

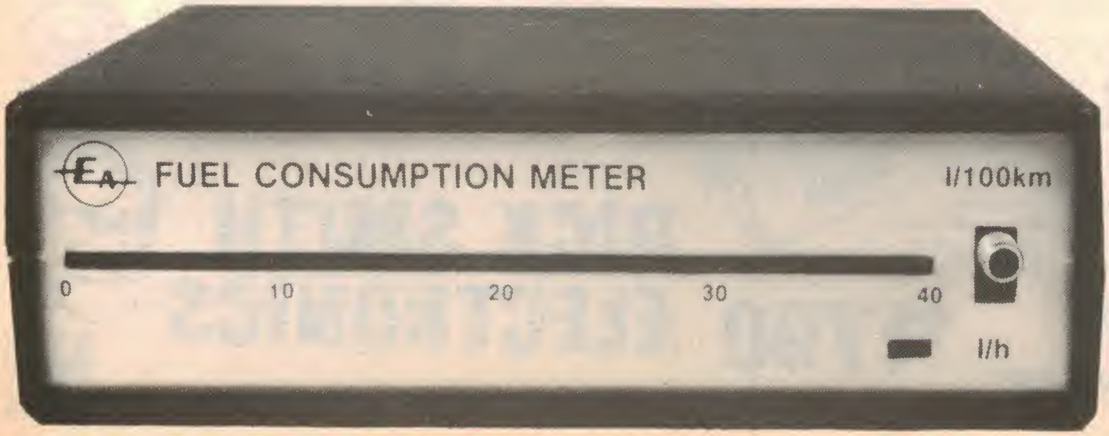
Once the unit is installed, you will find that you can easily modify your driving habits to obtain better fuel economy. In particular, you will be able to monitor the effects of rapid acceleration, gear selection and vehicle speed. The more LEDs that light up, the more it's costing you!

Out on the highway you can quickly determine the difference in fuel consumption between driving at, say, 100km/h and 120km/h. As you will discover, 100km/h is far more economical.

Bar graph display

Perhaps the most important feature of our Fuel Consumption Meter is the bar graph display. This is formed by 20 rectangular LEDs arranged side by side and, in this application, has several important advantages over the digital display used in the Car Computer. In particular, an analog display has virtually instantaneous response and you can tell what it is doing by merely glancing at it. It is not necessary to read and interpret numbers.

There is only one front panel control: a two-position slide switch that allows the



Watch the LEDs light up when you plant the right foot! The Fuel Consumption Meter can measure fuel consumption to 40l/100km or 40l/h.

unit to be switched from the l/100km mode to l/h as required. In addition, the unit automatically switches from l/100km to l/h when the vehicle stops (ie, when no pulses are being received from the disance sensor). The reason for this is that, when the vehicle is stationary, the l/100km mode becomes meaningless.

To understand why, consider what happens as the vehicle is brought to a stop. Initially, as the vehicle slows, the fuel consumption in l/100km decreases, then increases dramatically just before the vehicle stops. This is because, at very low speeds, the distance travelled between fuel pulses progressively decreases while the fuel flow rate remains fairly constant.

The limiting case is obviously at standstill, when fuel is used but no distance is travelled. The l/100km value then becomes infinite. Our Fuel Consumption Meter overcomes this problem by automatically switching to the l/h consumption mode about one second after the vehicle has stopped.

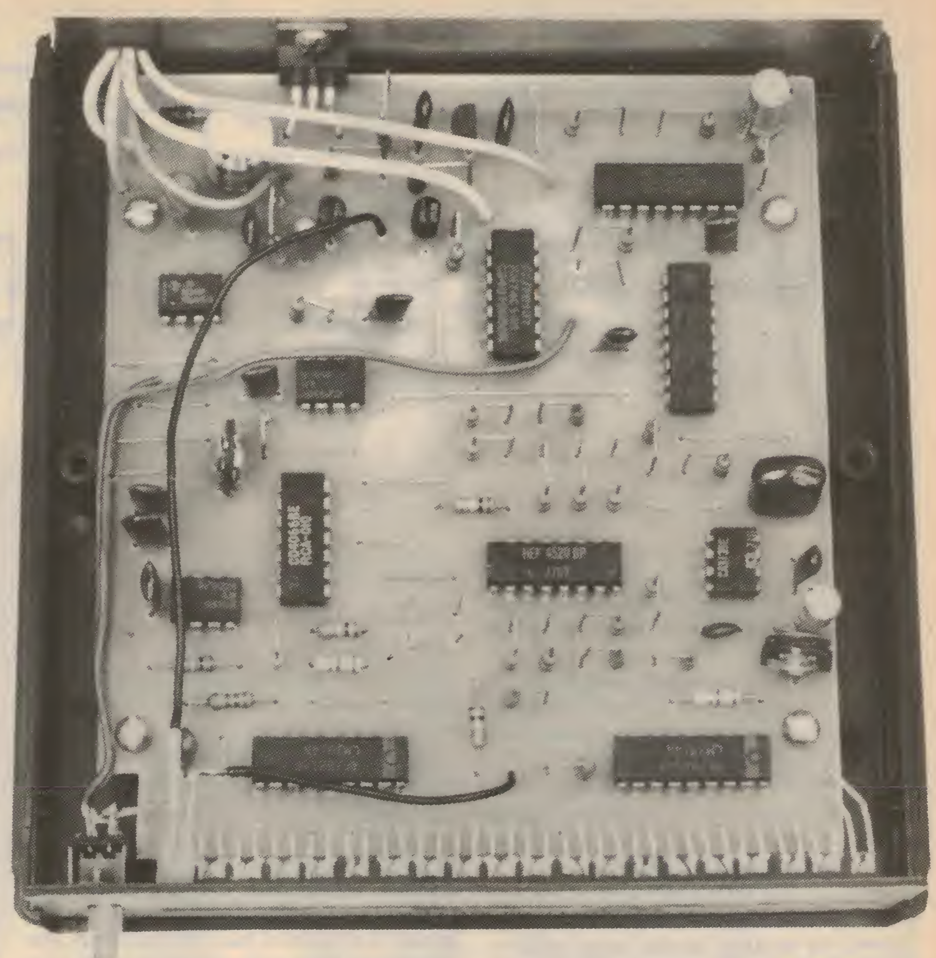
A green LED on the front panel provides visual indication that the meter is in the l/h mode. This LED operates regardless of whether the changeover is initiated manually or automatically.

As can be seen on the photograph, our prototype also features a "0-40" scale adjacent to the LED bar graph display. Despite this, accurate calibration of the unit is not really necessary since we are mainly interested in fuel consumption trends during driving rather than the exact instantaneous value. The value is of little importance as fuel consumption can vary quite rapidly from one instant to the next during everyday driving.

Is there a catch to any of this? Are there no disadvantages with our new Fuel Consumption Meter? Well,. we have to admit to one problem area in designing a suitable unit.

Due to the action of the needle valve in the carburettor, petrol flow through the fuel sensor tends to occur in short spurts rather than as a continuous flow. At times the needle valve may cut off fuel flow completely (depending upon the float level), thus giving readings of 0l/100km. At other times, the valve may open fully, even at light throttle openings, giving flow rates much higher than normal and causing full scale display readings.

This effect is much more pronounced in small cars (1.6 litres or less) than in big cars with three to four litres engine capacity. There is also a driver condition which upsets the operation of the device. We refer to this as the "three-second syndrome" and it applies to drivers who, in heavy traffic, accelerate, ease off, gaze at the traffic, and then accelerate again, and so on. Many drivers who have this habit are unaware of it (government bus-drivers, please note!).



Contruction is easy, with virtually all components mounted on a small PC board. Note that the board is mounted upside down in the case (see text).

For obvious reasons, this upsets operation since it is difficult to obtain a steady reading. Not only is the habit bad as far as the Fuel Consumption Meter is concerned, but it also promotes excessive fuel consumption. Even so, our circuit largely overcomes the effects of needle valve action and the "three-second syndrome" as we shall see later on in the circuit description.

Fuel and distance sensors

The fuel flow and distance sensors used in this project are exactly the same as those used in the EA Car Computer. In fact, both projects can share the same sensors if required — all you have to do is wire them in parallel.

The fuel flow sensor is branded "Moray" and consists of a miniature turbine with multiple vanes that interrupt a beam of infrared light to a phototransistor. It delivers around 17,000 pulses per litre, the exact figure varying somewhat from unit to unit, and is inserted in the fuel line between the fuel pump and the carburettor.

Two different types of distance sensor can be used: (1) a magnetic pick-up using a coil and rotating magnets; or (2) a speedometer cable sensor that uses vanes to chop an infrared beam to a phototransistor. Generally speaking, the magnetic pick-up system will suit rear-wheel drive cars as the tailshaft is an ideal place to mount the magnets. The speedometer cable sensor is more applicable to front-wheel drive cars.

Block diagram

Let's now discuss the general circuit features by referring to the block diagram (Fig. 1). We will consider the l/100km mode of operation first.

Pulses from the fuel flow sensor are first multiplied by 64 and the resultant signal used to clock the input of a digital-to-analog converter (DAC). At the same time, the distance sensor pulses are squared up and passed to a monostable. The output of the monostable is a train of narrow positive going pulses which perform the reset function for the DAC.

At the heart of the circuit is the digital-to-analog converter. It functions as follows: initially, the output of the DAC is reset to zero and the device begins counting clock pulses from the x64 multiplier. As shown on Fig. 1 the output of the DAC is a staircase waveform which increments one step each time a clock pulse is received. This staircase waveform continues to increment until a reset pulse is received, at which time the

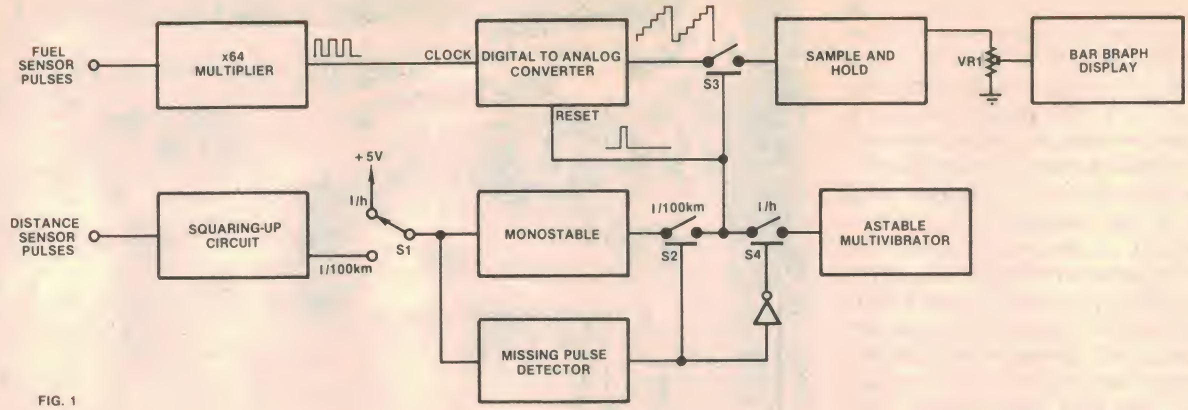


FIG. 1

output of the DAC is "frozen" and transferred to a sample-and-hold circuit. The DAC is then reset to zero ready for the next count.

In other words, the DAC counts up the number of pulses from the x64 multiplier between successive reset pulses, and converts the resultant binary number to an equivalent analog voltage. This analog voltage is then transferred to the sample-and-hold circuit, which in turn drives the bar graph display.

Since we are effectively using distance sensor pulses to gate through fuel sensor pulses, the voltage on the wiper of trimpot VR1 will be directly proportional to fuel consumption as a function of the distance travelled. By suitably adjusting VR1, we can get the display to read directly in l/100km.

Note that switch S3 is closed only during the reset pulse so that data can be transferred from the DAC to the sample and hold circuit. The switch is open at other times to ensure that the DAC has no effect on the sample and hold circuit during counting.

The sample and hold circuit, by the way, does exactly what its name implies – it samples the voltage at the output of the DAC, and holds that voltage until the next reset pulse arrives and the signal is updated (or re-sampled).

l/h mode

The l/h mode functions in similar fashion with the difference that reset pulses are now derived from an astable multivibrator. That's where the missing pulse detector circuit comes in. It detects the absence of distance sensor pulses when the vehicle stops, and automatically switches in the astable multivibrator via CMOS switch S4. At the same time, S2 opens to disconnect the monostable output (which will be low) from the reset line.

Switch S1 allows the circuit to be manually switched to the l/h mode by connecting the input of the missing pulse detector to the +5V supply rail.

Circuit details

The circuit is quite straightforward and uses 11 integrated circuits to carry out the various circuit functions referred to in the block diagram.

The output of the fuel sensor is connected to a x64 multiplier formed by a 4046 phase locked loop (IC1) and a 4020 14-stage binary counter (IC2). Operation of the PLL is as follows: Inside the 4046 is a phase comparator and a voltage controlled oscillator (VCO). One input of the phase comparator (pin 14) monitors the fuel flow pulses while the other (pin 3) is fed from the output of IC2. The comparator output (pin 13) drives a lag-lead filter network and is fed back to the input of the VCO (pin 9) via a 100kΩ resistor.

What happens is that the VCO adjusts its frequency so that its output after division by the 4020 is the same as the input frequency at pin 14. In other words the VCO output frequency at pin 4 is equal to the input frequency from the fuel flow sensor multiplied by the division factor of the 4020.

Result – the input signal from the fuel flow sensor is multiplied by 64, the division ratio of the 4020. This provides a large difference between the apparent pulse rates of the two sensors and improves the resolution of the meter.

Output pulses from the x64 multiplier are fed to the clock input of IC5, a dual synchronous up counter. This IC contains two binary up counters which we have connected in series to form a single 8-bit counter. An R:2R ladder network is connected to the Q1-Q8 outputs and converts the binary output of the 4520 to an equivalent analog voltage.

IC5 and the resistive ladder network thus form the required digital-to-analog converter.

Note that all the 47kΩ resistors in the ladder network should ideally be 50kΩ. In practice, any errors caused by using the 47kΩ values remain insignificant until the Q7 output is reached. At this point, it is necessary to use the correct value of 50kΩ (2x100kΩ in parallel) in order to avoid non-linearity problems.

Because it is quite possible to have very high fuel consumption under some conditions, it is necessary to include an over-range halt to prevent the possibility of ambiguous display readings. This function is performed by IC10f which disables the clock input of the 4520 when the Q8 output goes high. The 4520 counter then remains "frozen" at maximum count until the next reset pulse.

At other times, D4 is reverse biased and IC10f has no effect on circuit operation.

Let's assume first of all that the reset pulses are derived from the distance sensor (ie, the unit is measuring l/100km). Our circuit diagram shows a coil and rotating magnet assembly as the distance sensor, although the speedometer cable sensor can also be used.

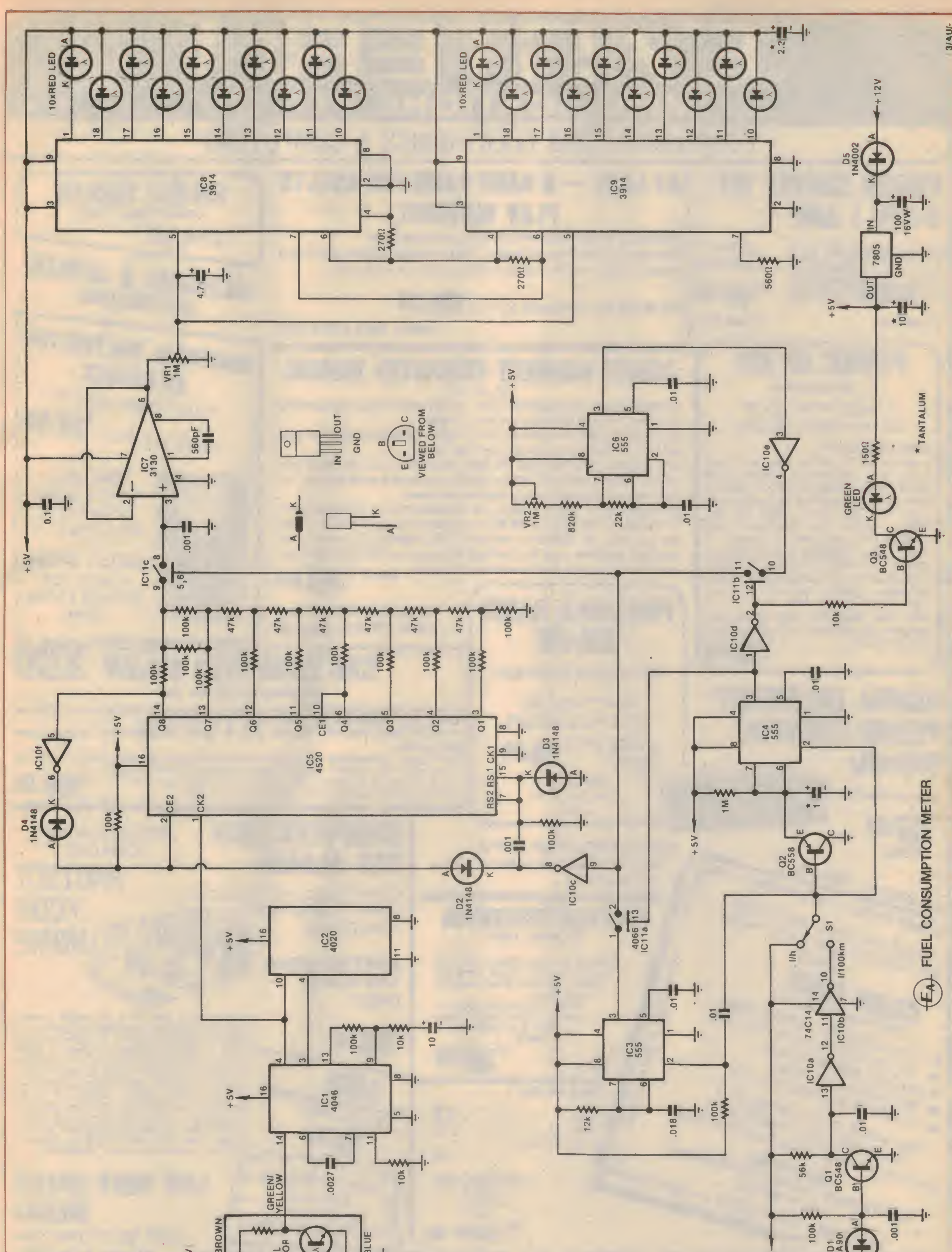
As the magnets rotate, they induce a signal voltage in the coil. This signal is half-wave rectified by germanium diode D1 and filtered by a .001μF capacitor. A BC548 transistor (Q1) provides the necessary gain and, after further filtering by a .01μF capacitor, the resulting waveform is squared up by Schmitt triggers IC10a and IC10b.

Note that if you elect to use the speedometer cable sensor, the sensor signal should be applied directly to pin 13 of IC10a. The diode, .001μF capacitor, 100kΩ and 56kΩ resistors, and transistor

We estimate that the current cost of parts for this project is approximately

$50

This includes sales tax, but does not include the cost of the fuel and distance sensors.



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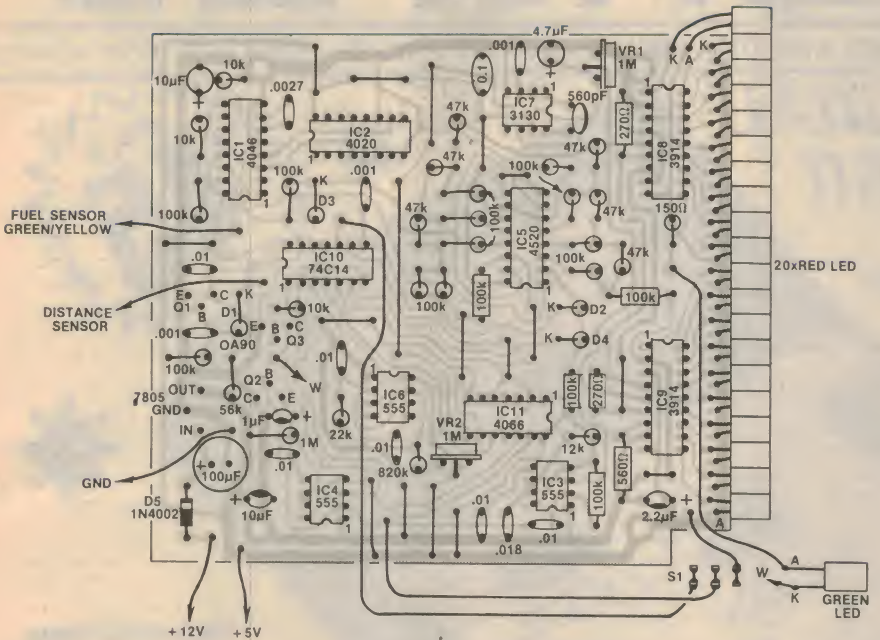
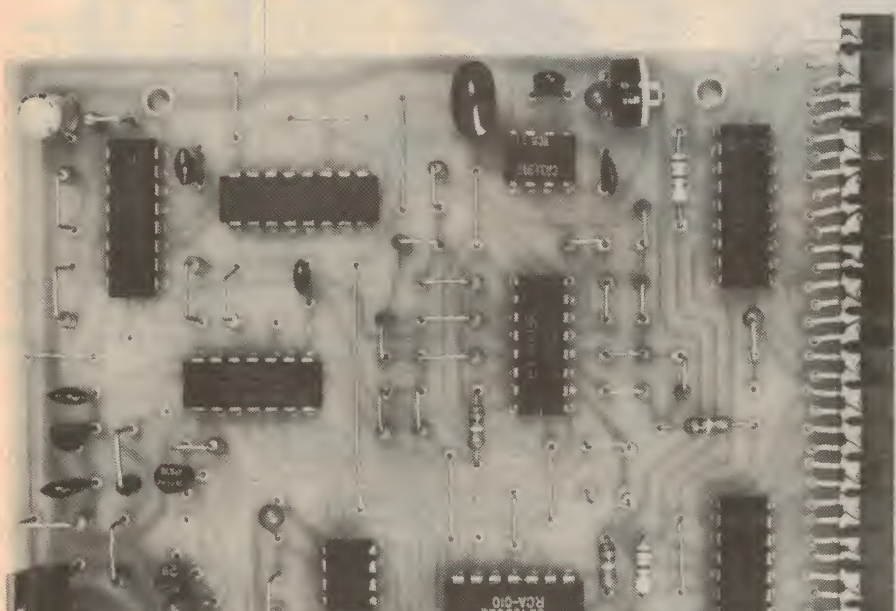


Part overlay diagram and life-size view of the assembled PC board. Not that the final version differs slightly from the unit shown in the photograph.



Q1 can then be deleted. The .01μF capacitor should be left in circuit.

The output of IC10b is passed via switch S1 and a .01μF capacitor to the trigger input of IC3, a 555 timer IC. IC3 is wired as a monostable and triggers on the negative going edge of a distance sensor pulse to produce a brief output pulse on pin 3. This output pulse – about 0.2ms long – passes via CMOS switch IC11a (which will be closed at this time), and forms the reset pulse.

The reset pulse does two things. Firstly, it causes pin 8 of IC10c and hence the clock enable (CE2) input of the 4520 to go low, thus preventing the 4520 from counting further clock pulses. Secondly, it closes CMOS switch IC11c to connect the output of the ladder network to the sample and hold circuit. Note that because the 4520 is inhibited while its CE2 input is low, the sample-and-hold circuit is presented with a fixed voltage to sample.

IC7, a 3130 FET-input op amp, forms the sample-and-hold circuit and is wired as a unity gain buffer. It works like this: When IC11c is closed by the reset pulse, the DAC output voltage is transferred to the .001μF capacitor at the non-inverting input of IC7. At the end of the reset pulse, IC11c opens again to isolate the capacitor from the DAC during counting.

Because the unity gain buffer has an extremely high input impedance, it follows that the voltage across the .001μF capacitor, and hence the output of IC7, will remain constant between reset pulses.

As well as opening switch IC11c, the end of the reset pulse also forces the output of IC10c to go high again. This transition causes a positive pulse to be delivered by the differentiating network on pin 7 and 15 of the 4520, and this resets the 8-bit counter to zero. Diode D3 clips the large negative going spike produced by the differentiating network at the beginning of a reset pulse, and is included as a precautionary measure.

The high output from IC10c also reverse biases diode D2, and so the clock enable input (CE2) of the 4520 is pulled high by the 100kΩ pull-up resistor. This allows the 4520 to begin counting clock pulses from the x64 multiplier again and so the cycle is repeated.

The sample and hold circuit drives the bar graph display via a 1MΩ calibration trimpot. IC8 and IC9 are bar graph display drivers, each capable of driving 10 LEDs. They are cascaded together to form a 20 LED display which covers the most used portion of the fuel consumption range – ie, 0 to 40 litres/100km or 0 to 40 litres per hour, depending upon the setting of the calibration trimpot.

LED current is set at 20mA by the 560Ω resistor and the two 270Ω resistors. This ensures adequate display brightness even in daylight.

Earlier on, we described how needle valve action in the carburettor could upset the operation of the Fuel Consumption Meter, particularly on cars with small four-cylinder engines. In most cases, however, this effect can be eliminated by filtering the output of the sample and hold circuit, and this is the job of the 4.7μF electrolytic capacitor connected to the wiper of VR1.

Note that the value of the capacitor

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LOW COST DIGITAL MULTIMETER KIT

BY POPULAR DEMAND

Ref: EA March 1983 (This month)
Almost everyday we are asked for a multimeter kit. Up until now we thought that it was just not worth it considering the fine low-cost built-up units available. The DP2010 changed all that.
This kit, fully imported from the UK uses the famous DPM-05 custom LCD/Voltmeter to achieve phenomenal accuracy at very modest cost!
All parts are included to complete the meter including an attractive and colourful front panel.
(a 9V battery is required)

ONLY $45

Set of test probes to suit $2.95
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Eveready 216 (red) 9V Battery Cat. SB2370 ONLY $1.40

DP2010 kit Cat. KJ7010 ONLY $45

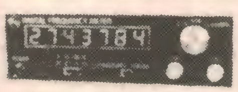
SPECIFICATIONS

Function	f.s.d.	Resolution	Accuracy	Protection
Volts (d.c.)	2V	1mV	1%±1 digit	500V for
	20V	10mV	1%±1 digit	one minute
	200V	100mV	1%±1 digit	
	500V	1V	1%±1 digit	
Current (d.c.)	2mA	1uA	1%±1 digit	1A/250V
	20mA	10uA	1%±1 digit	
	200mA	100uA	3%±1 digit	
	2000mA	1mA	5%±1 digit	
Volts (a.c.)	2V	1mV	2%±5 digit	500V for
	20V	10mV	2%±5 digit	one minute
	200V	100mV	2%±5 digit	
	500V	1V	2%±5 digit	
Current (a.c.)	2mA	1uA	2%±5 digit	1A/250V
	20mA	10uA	2%±5 digit	
	200mA	100uA	4%±5 digit	
	2000mA	1mA	7%±5 digit	
Resistance	2K	1	1%±1 digit	260V
	20K	10	1%±1 digit	r.m.s.
	200K	100	1%±1 digit	
	2000K	1K	1%±1 digit	
Diode Test	2V	1mV	1%±1 digit	260V r.m.s.

AC VOLTAGE AND CURRENT RANGES
When S3a selects a.c. functions the output from either the voltage attenuator or current shunts is fed through C1 to remove any d.c. component.

500MHz Digital Frequency Period Meter

REF: EA Dec '81 — Feb '82



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Other people may appear to be selling this kit for less. But you GET less!!! Exclusive Jaycar features.
* Heavy gauge front panel. Pre-punched and silkscreened. (NOT Scotchcal). * Low aging rate 10.000MHz crystal * Quality IC sockets provided (A MUST) * All metal film resistors used (1% 50ppm) * Thermalloy heatsink for +5V reg.
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50MHz version $119 Cat. KA1390
Tilting bail to suit ONLY $4.95

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Short Form Version Only $39.50
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Ref: EA September 1982

COMPLETE ONLY
$49.50
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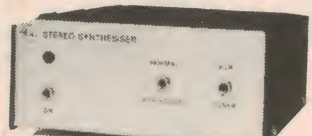
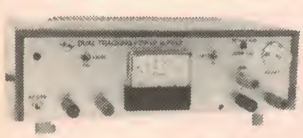


EA dual tracking P/S



Extremely versatile power supply: Will give plus & minus 1.3V to 22V at up to 2 amps PLUS A FIXED +5V@0.9A. The supply is completely protected against short circuits, overloads and thermal runaway. A large meter with voltage calibration is supplied as well as IC sockets. A quality kit.

Ref EA March '82
Cat. KA1410
$89.50

HEART RATE MONITOR

Ref: EA 7/82

This unit enables you to measure your own pulse instantly and accurately. It is light enough even for joggers to carry. A must for people who may have heart problems.
Complete kit including LCD Display.

Cat. KA1466

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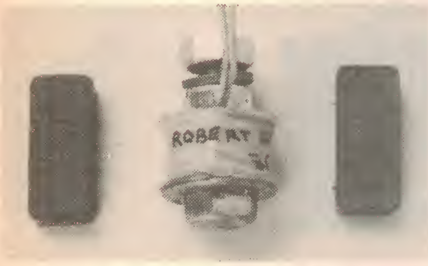
Fuel consumption meter

Moray fuel flow sensor (left) and matching T-piece (right). The T-piece is used only in cars which have recirculating fuel systems.



Distance sensors: magnetic pick-up sensor (above) and speedometer cable sensor (right).

may have to be varied to suit individual model cars. There is a limit, however – if the capacitor value is made too large it will also filter out the effects of fuel consumption changes!

The missing pulse detector consists of a 555 (IC4) wired as a monostable, with a PNP transistor (Q2) connected across the timing capacitor. As stated earlier, its job is to detect the absence of distance sensor pulses and then automatically switch the circuit to the l/h mode.

When the car is moving, pulses from the distance sensor trigger the monostable and also turn on Q2, which discharges the timing capacitor so that the monostable cannot complete its timing cycle. Thus, the pin 3 output of IC4 remains high and the meter remains in the l/100km mode while ever the time between distance sensor pulses is shorter than the monostable timing period (about 1s).

When the car stops, however, there are no distance sensor pulses to turn on transistor Q2, and so the 1μF capacitor is able to charge via the 1MΩ resistor. After about one second, the monostable completes its timing cycle and the pin 3 output of IC4 is forced low. This opens CMOS switch IC11a and at the same time, closes CMOS switch IC11b via inverter IC10d. Reset pulses to the 4520 and to IC11c are now supplied by IC6.

IC6 is a 555 timer wired as an astable multivibrator and has been arranged so that its duty cycle is almost 100%. When the output is inverted by IC10e, the result is a series of short positive reset pulses about 0.2ms long as before. Trimpot VR2 provides adjustment of the output frequency (nominally 100Hz) and allows the unit to be calibrated to suit different fuel flow sensors.

Transistor Q3 is controlled by the output of IC10d. It turns on to drive the green indicator LED when the unit switches to the l/h mode (ie, when the output of IC10d is high).

Manual changeover to the l/h mode is accomplished by using S1 to switch the base of Q2 to the +5V rail, thus turning Q3 hard off and allowing IC4 to complete its timing cycle.

Power for the Fuel Consumption Meter is derived from the 12V battery. A diode and a 100μF capacitor filter the battery voltage and a 7805 three-terminal regulator supplies +5V directly to the circuit. The 10μF tantalum capacitor provides supply decoupling and ensures stability of the regulator.

Construction

The circuit is built on a printed circuit (PCB) coded 83fc2 and measuring 116x105mm. Before commencing assembly, a small piece should be cut out of one corner of the PCB as shown on the parts overlay diagram. The boundaries for the cut-out are the edge of the +5V track and the dotted line.

This done, assemble the PCB according to the parts overlay diagram but do not mount the three-terminal regulator at this stage. Pay particular attention to the

PARTS LIST

1 printed circuit board, code 83fc2, 116x105mm
1 Scotchcal front panel, 121x33mm
1 instrument case, Cadin/Clift Model IC-1 or Pactec model CM5-125
1 SPDT slide switch
1 rubber grommet
4 12mm plastic PCB standoffs
1 Utilux 12-way line socket and panel plug
1 fuel flow sensor
1 distance sensor (see text)
1 piece of aluminium, 121 × 33 × 1mm
4 12mm self-tapping screws

SEMICONDUCTORS
3 555 timer ICs
1 4046 CMOS phase locked loop
1 4020 CMOS 14-stage binary counter
1 4520 CMOS dual synchronous up counter
1 74C14 or 40106 CMOS hex Schmitt trigger
1 4066 CMOS quad bilateral switch
1 3130 Fet-input op amp
2 LM3914 LED display drivers
1 7805 3-terminal +5V regulator
2 BC547, BC548 or BC549 transistors
1 BC557, BC558 or BC559 transistor
1 OA90 germanium diode
1 1N4002 diode
3 1N4148 diodes
20 rectangular red LEDs
1 rectangular green LED

CAPACITORS
1 100μF 16VW PC mounting electrolytic
1 10μF 25VW tantalum or LL type
1 10μF 10VW PC mounting electrolytic
1 4.7μF 10VW PC mounting electrolytic
1 2.2μF 35VW tantalum or LL type
1 1μF 35VW tantalum or LL type
1 0.1μF greencap
1 .018μF greencap
6 .01μF greencaps
1 .0027μF greencap
3 .001μF greencaps
1 560pF ceramic

RESISTORS (all ¼W, 5%)
1 × 1MΩ, 1 × 820kΩ, 16 × 100kΩ, 1 × 56kΩ, 6 × 47kΩ, 1 × 22kΩ, 1 × 12kΩ, 3 × 10kΩ, 1 × 560Ω, 2 × 270Ω, 1 × 150Ω, 2 × 1MΩ miniature vertical trimpots

MISCELLANEOUS
Machine screws and nuts, rainbow cable, light duty hook-up wire, solder, mounting brackets, etc.

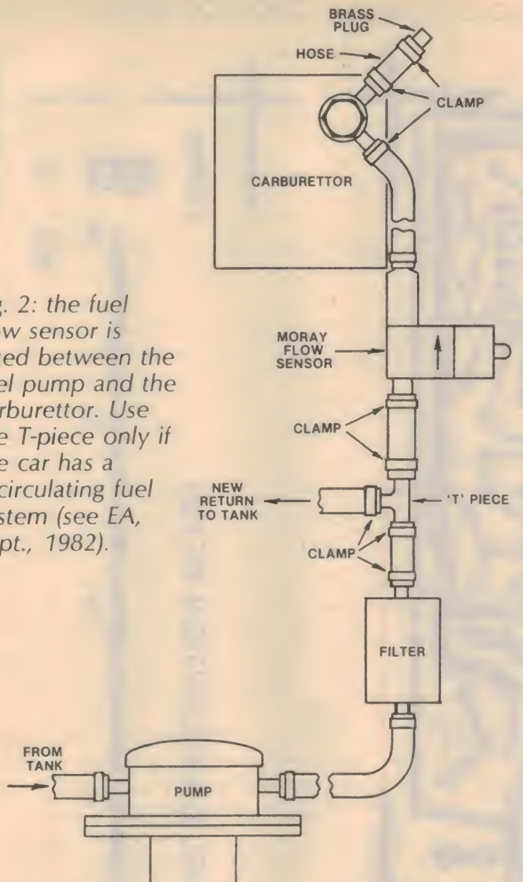


Fig. 2

Fig. 2: the fuel flow sensor is fitted between the fuel pump and the carburettor. Use the T-piece only if the car has a recirculating fuel system (see EA, Sept., 1982).

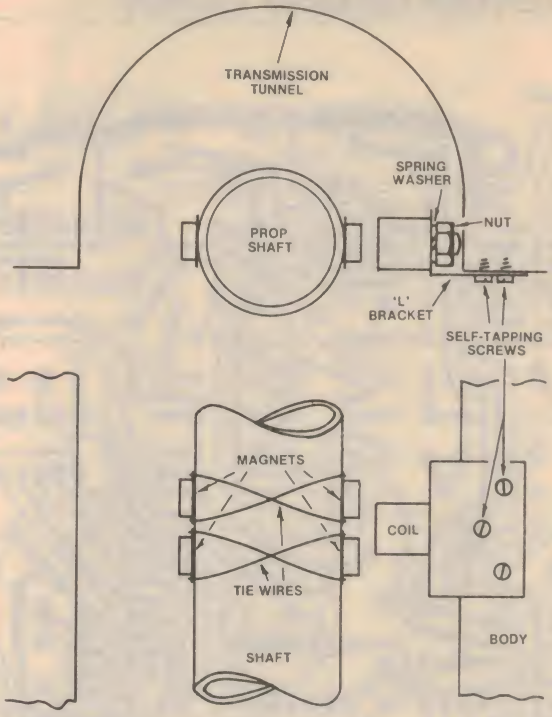


Fig. 3

Figs. 3 & 4 show how the magnetic pick-up sensor is installed in rear-wheel drive and front-wheel drive cars respectively, while Fig. 5 shows the wiring for the 12-pin Utilux socket (as viewed from the front).

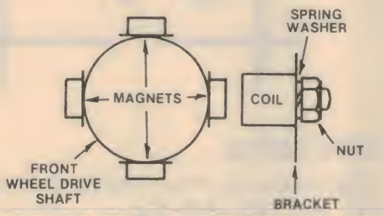


Fig. 4

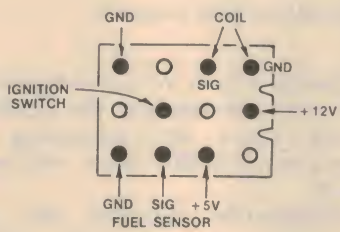


Fig. 5

orientation of polarised components and note that some of the resistors and diodes are stood on end to conserve board space. The LEDs are mounted side by side, with their leads bent through 90° and with the back edge of each LED butted against the edge of the PCB.

Make sure that the LEDs all line up and that you mount them the right way round — the anode lead is the longer of the two.

Several of the ICs (IC1, 2, 5, 10 & 11) are CMOS devices, so the usual precautions apply when soldering them into circuit. Earth the barrel of your soldering iron to the earth track on the PCB using a small clip lead and solder the power supply pins first to enable the internal static protection circuitry. No special precautions are required for the remaining ICs other than to ensure correct orientation.

A standard plastic case measuring 129x131x40mm (WxDxH) is used to house the PCB. We used a Model IC-1 case manufactured by Cadin/Clift Electronics (2a Cromwell St, Burwood, Victoria), but you can also use the Pactec Model CM5-125 case. A front-panel label made from self-adhesive Scotchcal material was used to provide an attractive finish.

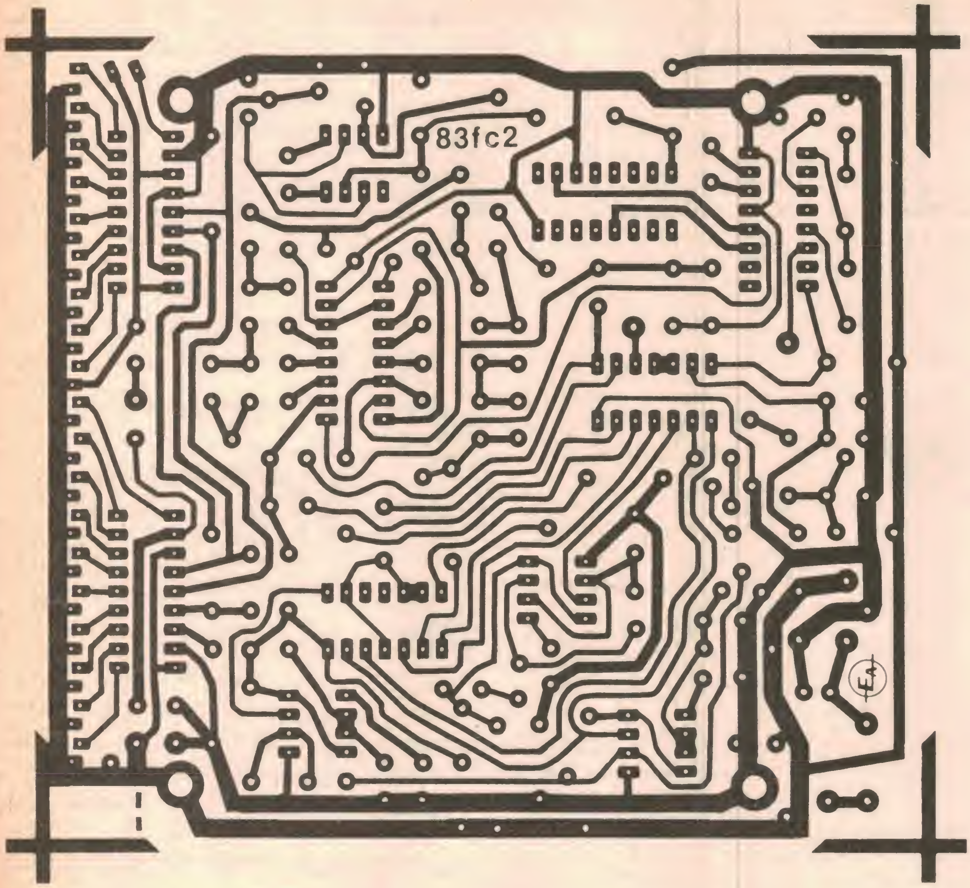
Spray the Scotchcal label with a hard-setting lacquer (eg, "Estapol") to prevent scratches, then carefully trim it to size using a sharp knife to score along the edges. The label can now serve as a template to make the front panel cutout for the slide switch.

The slide switch is mounted using two countersunk cheese-head screws hidden behind the Scotchcal label. Cut out the switch actuator area on the Scotchcal label using a sharp knife, then using the Scotchcal as a template, mark the switch cutout area on the plastic panel. The switch cutout is now made by using a drill to remove most of the material and then filing to a neat rectangular shape.

Next drill and countersink the switch mounting holes and screw the switch into position. The Scotchcal label should now be carefully fixed to the front panel and holes drilled and filed to shape to take the LED bar graph display and the indicator LED. Proceed carefully with this step, periodically offering the front panel to the bar graph display so that you can judge how much progress is being made. The job is admittedly tedious but requires care to ensure that the LED bar graph is a tight fit in the front panel cutout.

The PCB assembly is mounted upside down in the case. Carefully push the LED display into the front panel cutout so that the LEDs sit slightly proud of the surface, then position the assembly in the lid of the case so that the PCB mounting holes line up with the case pillars. You are now ready to mount the regulator IC.

To do this, first bend the leads forward so that they make an angle of 90° with the body of the regulator. The leads are then bent down 90° so that, when the regulator is mounted on the PCB, its metal tab sits flush against the back panel (see photograph). Once the cor-



Here are actual size artworks for the PC board and the front panel.

rect mounting arrangement has been determined, the PCB can be removed from the case and the regulator soldered permanently in position.

Heatsinking for the regulator is provided by replacing the plastic back panel with an aluminium panel. Two holes must be drilled in this panel: one to accept the regulator mounting bolt and another through which to pass external leads. The latter should be fitted with a small rubber grommet.

The remaining wiring can now be completed according to the parts layout diagram. We used rainbow cable for the wiring connections to the switch and front panel indicator LED, and light duty hook-up wire for external connections to the power supply and sensors. These external connections are terminated in a Utilux line socket wired in exactly the same manner as for the EA Car Computer.

Finally, the whole assembly can be fitted to the lid of the case and secured using suitable plastic standoffs and 12mm-long self-tapping screws. Note that it may be necessary to trim the standoffs slightly so that they will fit between the PCB and the case pillars.

Ideally, the Fuel Consumption Meter should be installed on top of the dashboard, directly in front of the driver. We'll leave the details to the individual reader, since the mounting arrangements will differ from vehicle to vehicle.

Installation of the fuel flow and distance sensors was covered in detail in the September 1982 issue as part of our description of the EA Car Computer. Fitting is straightforward and will be largely self-evident from the accompanying diagrams. Even so, readers should refer to the September issue as there are a number of important guidelines that must be followed.

Fig. 5 shows the recommended wiring for the 12-pin Utilux socket, as viewed from the front. The leads from the sensors are passed through the firewall and terminated to the appropriate mating pins on the matching plug. Make sure that you get these connections right, otherwise the circuitry could be damaged.

The +12V supply should be switched by the ignition switch, and can be obtained from the fusebox. Check the voltage available with a multimeter before actually connecting the +12V lead, and make the connection to the fused side. The ground connection can be made at any suitable chassis point.

Calibration

Calibration involves adjusting trimpots VR1 and VR2 while the car is driven at a steady 50km/h along a straight level road. In the interests of safety, we strongly recommend that you carry out these adjustments with the aid of an assistant.

If you have a Car Computer fitted, it is simply a matter of switching to the l/100km mode and adjusting VR1 to give the same reading as the Car Computer. The Fuel Consumption meter is then switched to the l/h mode and VR2 adjusted so that the display shows half the previous l/100km reading.

If you don't have a Car Computer, the procedure is to adjust VR1 so that the display shows the average fuel consumption of the car (for a steady 50km/h). The unit is then switched to the l/h mode and VR2 adjusted for half the previous reading as before. Note: it is important that the car be maintained at a steady 50k/mh during these adjustments.

That's it! Your Fuel Consumption Meter is now ready to show you what a lead-footed "petrol-head" you really are.

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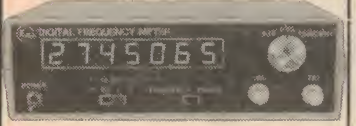
7 Digit Resolution, measures period and frequencies to • 500 MHz

Professional unit — cost a fraction of similar built-up units.



This project is "so easy to construct", virtually all components mount on one single PCB, ensuring success even for the "not so experienced" constructor.

Use of the latest LSI circuitry ensures impeccable performance from the completed unit. This is further ensured by our use of top grade components.

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High Input Sensitivity 10MV to 30MHz, 100MV at 50MHz 1MOHM input impedance, 200MV 500MHz 75 OHMS input impedance.

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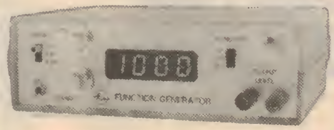
(with digital display)

Sine, triangle and squarewaves : 15Hz — 250KHz.



The most essential piece of test gear (second only to a good multimeter) on any hobbyist's bench is some kind of audio signal generator. This design utilizes the latest circuit techniques to produce stable, low distortion waveforms.

A truly versatile unit at a bargain price.

- 4 digit frequency readout (eliminates tiresome dial calibration) typical accuracy ± 2%.
- 3 overlapping ranges ×1, ×10, ×100.
- 600 OHM Nominal Output — continuously variable 3MV 2.5V P-P.
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- Squarewave rise time — 6V/uz maximum output.
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With the exception of the display all components mount on a single PCB making this kit suitable for all constructors.

K2505 . . . . $85.00

ANALOG / DIGITAL STORAGE CRO ADAPTER

(See EA Nov 1980 and March 1981).

Unit enables indefinite storage of non-repetitive waveforms at a fraction of the cost of conventional storage CRO's. National semiconductors A—D/D—A conversion techniques allow analog signals up to 100KHz to be stored • two channels while in digital mode • positive and negative edge triggering • AC/DC/HF and LF rejection • timebase tracer for accurate frequency measurement • accurate down to 1.9Hz Analog mode — 1us Digital Mode • delayed trigger 10us-1s • sensitivity 160MV P P 1 MEG (Analog)* standard TTL and CMOS levels 3-15 volt supply (Digital).

The features of this unit are to numerous to list, yet is simple to operate.

Be assured of quality with an Altronics Kit.

1. Genuine National A D conversion chips not second sourced dropouts.
2. All IC sockets provided (27 total — you pay no more)
3. Low capacitance coax and a full metre of rainbow cable.
4. Full instructions and every last nut, bolt and washer.
5. Deluxe mini rack cabinet.

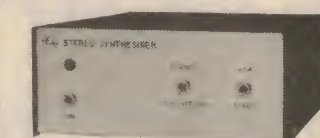
K2600. . . . . $189.00

STEREO SYNTHESIZER FOR TUNERS & VCR's

(See EA Sept. 1982)

Synthesize realistic stereo from virtually any monophonic source by simply connecting this unit between the source and your stereo amplifier.

ENJOY THE PLEASURES OF STEREO SOUND



- Quality Phillips MN3001 (not second source dropout)
- Provision for 2 different signal sources.
- Selection of either source via front panel switch.
- Normal or stereo sound selection.
- Complete kit includes all hardware, cables etc., even solder.

Important * beware of Kitset suppliers who sell this kit for less * you get less!!.

K5810. . . . . $55.00

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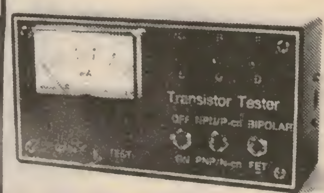

Electronics Australia Project Tests Bipolar Transistors, Diodes, Fets, SCR's and PUT's. Excellent service aid for the hobbyist and serviceman. Complete kit and instructions.

K 2525 . . . . $19.75

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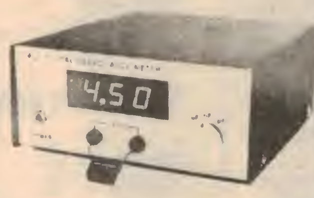
• • • • Exclusive to Altronics • • • •

Each kit includes precision measured capacitors for accurate calibration of each range.

K2520. . . . . $49.50



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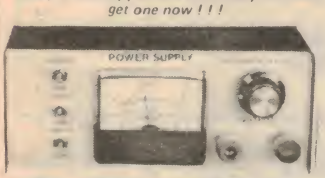

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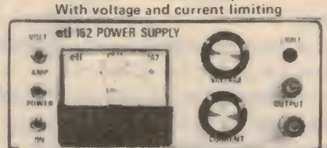
With voltage and current limiting



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- LED indication of current limit.

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K3205. . . . . $49.50

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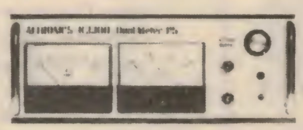

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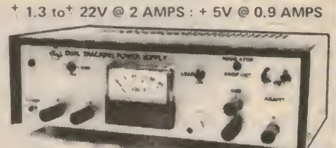

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K3220. . (EA MARCH 1982) . . $86.00

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Final article has useful troubleshooting procedure

A high performance AM tuner: Pt. 4

This comprehensive trouble shooting article will enable a quick repair for virtually any fault condition experienced with the AM Tuner. No extra tools or equipment are necessary in the fault finding procedure.

by JOHN CLARKE

While most readers will have successfully aligned their tuner without problems, there will be the unfortunate few who experience difficulty with some aspect of the circuitry. Perhaps when the tuner was first switched on a fault became evident or alternatively a problem arose during alignment. In either case this article will aid in locating the problem.

As is the case with any fault finding procedure, the problem must be attacked logically and with suitable test equipment. To allow this we have produced trouble-shooting charts which methodically trace through the relevent portions of the circuit. Testing is performed by measuring voltages at key points on the circuit, and a table of expected voltages is provided. Use is made of the alignment unit described last month to provide a suitable RF signal where necessary as well as buffering for the multimeter.

The trouble-shooting charts for the entire AM Tuner and Digital Tuner Readout circuitry are listed under six separate headings any of which can be considered as starting points for fault finding. Two of these starting points are the key locations observed while aligning the tuner: No Signal at Test Point 1 (TP1), and No Signal at Test Point 2 (TP2). The remaining four are all physically observable problems: No Audio, Distortion, No Signal Level Display, and Tuner Readout Display Fault.

It is important that the charts be followed in a logical sequence by testing each block before moving to test the next block. Also each starting point of the chart should be followed in the correct order such that starting points preceding a fault area be tested first. For instance, TP1 should be tested for a signal before testing at TP2. Again, TP2 should be tested first if there is no signal level display or audio signal.

Each block of the chart involves measuring a signal or DC voltage on the circuit and the accompanying voltage table shows those voltages as measured on our prototype tuner. Note that these voltages can be used as a guide only. Generally a correctly operating tuner will exhibit similar voltages to those depicted provided that the readings are made ex-

Voltage Table

TUNER SIGNAL VOLTAGES

		NOTES
Drain of Q1	1.1V	2,3,4
Emitter of Q6	1.0V	2,3,4
S1 of winding L5	1.2V	2,3,4
Drain of Q2, Q3	0.9V	2,3,4
Drain of Q4	2.8V	2,3,4
Drain of Q5	2.8V	2,3,5
Pins 1&2 of IC6	0.8V	2,3,5,6
Pins 10&11 of IC6	0.1V	2,3,5,6
Pins 8&9 of IC6	0.3V	2,3,5,7
Pins 3&6 of IC2	0.2V	2,3,5,7
Pin 3 of IC4	0.1V	2,3,5,7
Pin 6 of IC4	4.0V	1,3,5,7
Pin 6 of IC5	5.7V	1,3,5,7
Pin 17 of IC7	3.0V	1,3,5,7
Pin 3 of IC7	2.0V	1,3,5,7

TUNER DC VOLTAGES

		NOTES
Source of Q1	0.3V	1,3
Source of Q2	2.1V	1,3
Source of Q3	1.9V	1,3
Source of Q4	0.3V	1,3
Source of Q5	0.3V	1,3
Base of Q6	3.9V	1
Base of Q7	1.6V	1
Base of Q8	−1.6V	1
AGC	−1.3V	1,8

DIGITAL TUNER READOUT SIGNAL VOLTAGES

		NOTES
Gate of Q1	0.1V	2,9
Source of Q1	0.1V	2,9
Pins 6&7 of IC1	0.2V	2,9
Pins 14&15 of IC1	0.2V	2,9
Pins 2&3 of IC1	0.2V	2,9
Collector of Q2	1.0V	2,9
Pin 8 of IC18	2.5V	1
Pin 2 of IC19	0.4V	1
Pin 7 of IC19	0.4V	1
Pin 12 of IC19	2.5V	1

NOTES:
1. Measured with 20kΩ/V multimeter set for DCV.
2. Measured using buffer from alignment unit and 20kΩ/V multimeter set for DCV.
3. Link LK2 inserted.
4. 600kHz alignment unit oscillator signal at antenna input with no attenuation. Oscillator and tuner set for 600kHz.
5. 600kHz alignment oscillator signal attenuated with 470kΩ resistor in series to antenna input.
6. Wide/Narrow switch set to narrow position.
7. Wide/Narrow switch set to wide position.
8. Attenuator adjusted for full scale deflection on LED signal meter.
9. Local oscillator connected to Digital Tuner Readout.

actly as we have measured them. The method and conditions of measurement are listed as notes at the base of the table.

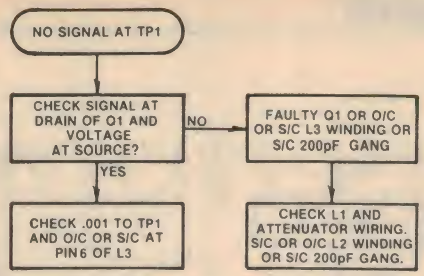
Most of the vertical flowing blocks ask the question whether the signal levels are sufficient at that part of the circuit. In response the chart is followed either vertically for a Yes (Y) if satisfactory, to answer further questions along the circuit, or horizontally for a No (N) where possible causes of the low signal level are noted.

Some of the possible causes listed are Open Circuit (O/C) connections which can easily be checked with a multimeter set on the "ohms" range with the power to the tuner off. Short Circuits (S/C) may be more difficult to check particularly with the tuning coils which have a resistance of about 10Ω. In this case it will be necessary to very precisely adjust the "ohms adjust" control on the multimeter to give a reading of zero with the meter probes shorted. The coil resistance should show a small deflection of the meter needle if not shorted.

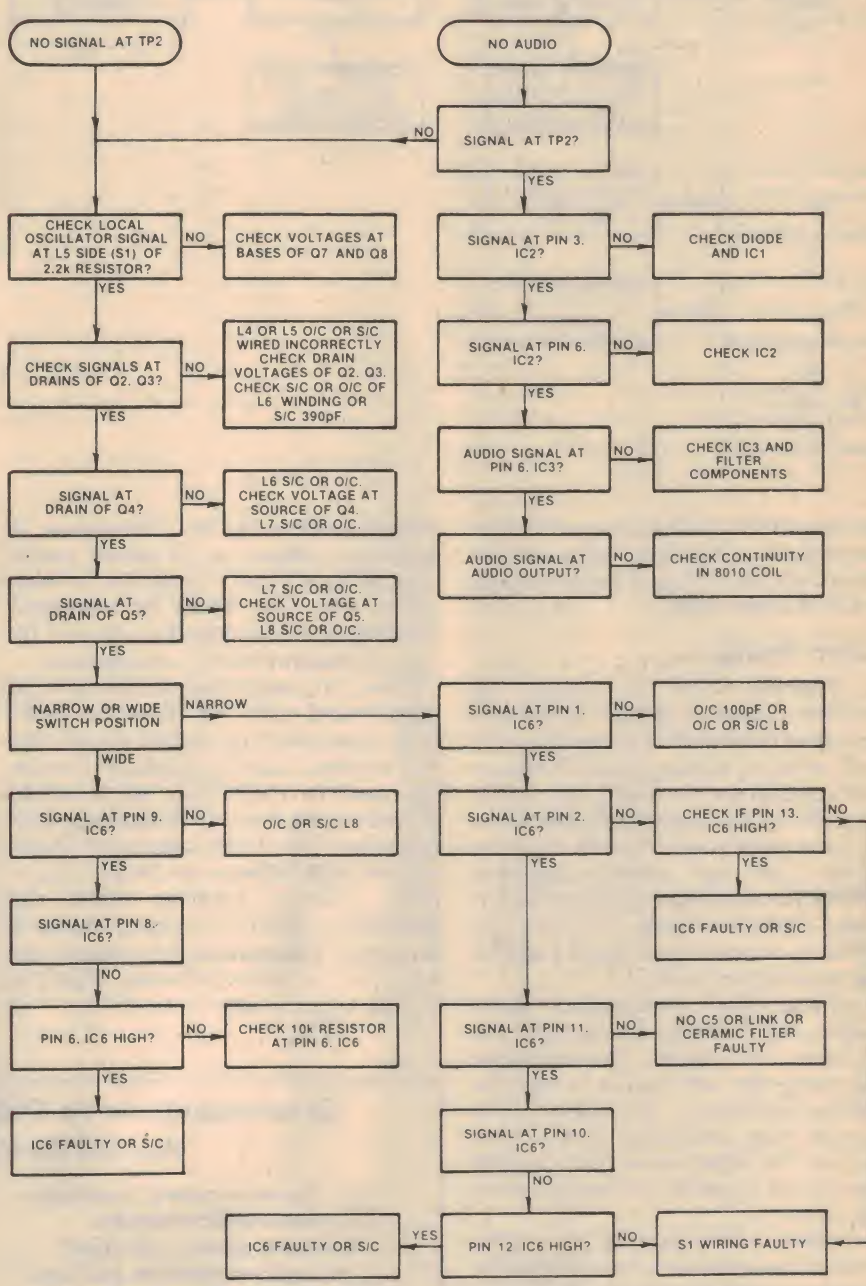
Diodes are easily checked by using the multimeter on the "ohms" range and measuring the resistance in both directions. One direction should show a low resistance when the positive lead is at the anode and the high resistance reading when the positive lead is at the cathode. Note that the majority of multimeters, when on the "ohms" range, apply a positive voltage on the common lead of the meter, however, the manual should confirm this. In most cases it will be necessary to lift one side of the diode from the PCB before checks can be made.

Where a possible fault block suggests checking an IC, this involves testing power supplies, checking for any short circuit tracks between the IC pins and for dry joints by measuring the resistance between the IC pin and copper track. If these tests are OK and the fault persists, then the IC can be considered suspect.

Checking FET operation can only be done satisfactorily with the FET in circuit. The source voltages of each FET are listed in the Tuner DC Voltage table to indicate the voltage for a correctly biased FET. If all other tests are OK, such as no S/C or O/C coils and no shorting capacitor plates, and no signal is present at the drain, then the FET can be considered suspect.



These two flowcharts show the troubleshooting procedure for the following conditions: no signal at TP1, no signal at TP2, and no audio.

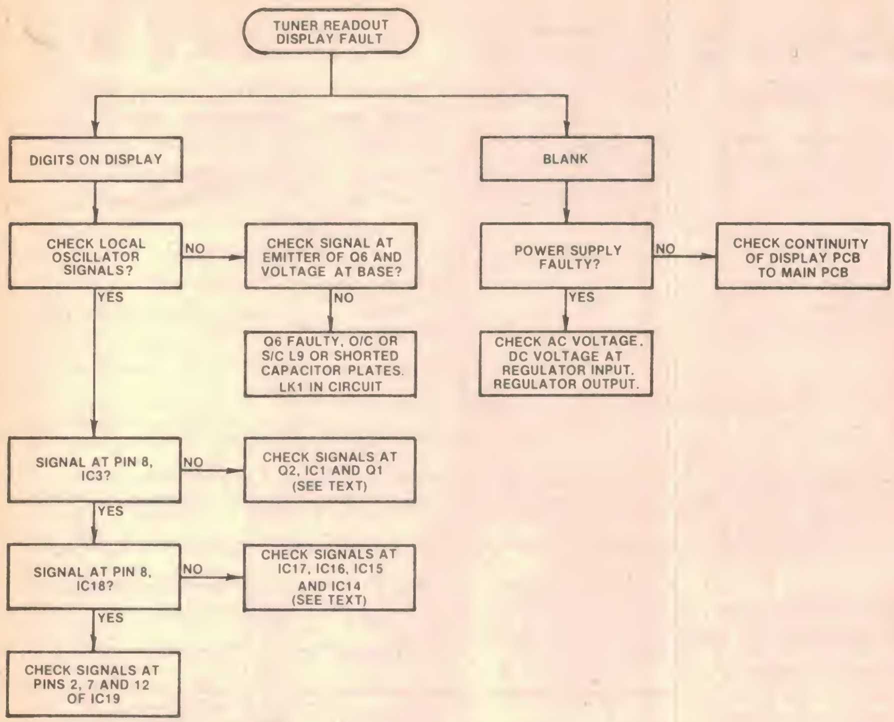


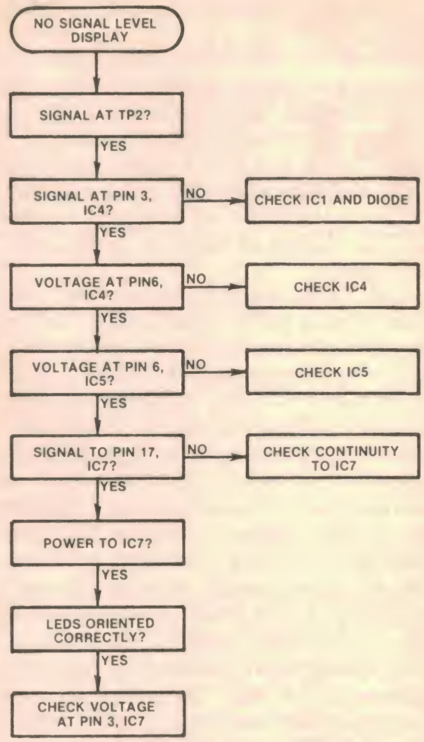
Tuner readout faults

When checking the Digital Tuner Readout circuit, voltages are given for digital signals. For example pin 8 of IC18 gives a reading of 2.5V which represents the average voltage produced by the 50% duty cycle signal. Similar voltages can be measured at pin 12 of IC17, 16, 15 and 14. Lack of voltages at any of these points may indicate a faulty IC, shorted pins or open circuit connections.

The Latch Enable, LE, pin 5 can be traced on IC12, IC11, IC10 and IC9 and should read about 4.4V on the multimeter. The Preset Enable, PE, on pin 1 of IC5, IC6, IC7 and IC8 should read 0.4V.

The following voltages must be measured while the local oscillator is applied to the input of the digital tuner readout. If the voltage at the collector of Q2 is correct then the signal can be followed to pin 2 of IC3 which should read 2.5V due to the 50% duty cycle. Similarly the voltage at pin 12 of IC4





should read 2.5V. If the signal at Q2 is incorrect then it should be followed back through IC1 and Q1 and these voltages are listed in the table.

Tuner faults

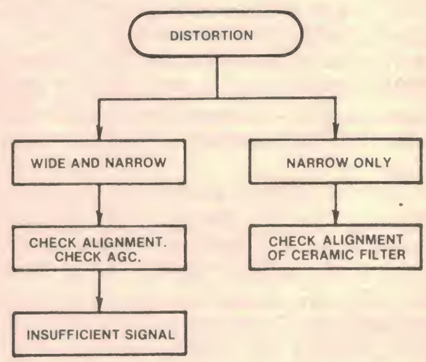
Most of the Tuner DC voltages are measured using a 20kΩ/V multimeter with link LK1 inserted. This prevents AGC action affecting the readings. The tuner signal voltages are measured mainly with the buffer of the alignment unit which drives the multimeter. The RF source is derived from the 600kHz alignment oscillator (set to 600kHz) and connected to the antenna input. To set the frequency, use the Digital Tuner Readout as described last month.

Note that while no attenuation of the signal is used to reduce the signal of this oscillator for signal measurements preceeding Q5, attenuation is used for measurements from Q5 onward. This prevents the following stages from overload. The attenuation control of the tuner should be set for no attenuation in both cases.

To attenuate the signal a 470kΩ resistor is inserted in series between the 600kHz alignment oscillator output and antenna input. This method of attentuation is used rather than setting the signal level display with the attenuator (as described in the alignment article last month) since it cannot be guaranteed that the circuitry up to the signal level display is functioning correctly.

Before proceeding with fault finding, inspect all the PCBs for correct component positioning and orientation. In addition, voltages on all power supply pins of the ICs and supplies to the transistors and FETs should be measured. The wiring should also be checked for correctness and broken connections.

Some of the most likely problems to be experienced with the tuner are faulty FETs, incorrectly terminated toroid coils and shorting capacitor plates on the tuning capacitor. Faulty FETs are found by measuring the source voltage as described earlier. Toroid windings can be checked with a multimeter set on the "ohms" range. Shorting capacitor plates can generally be heard to scrape as the gang is rotated. Often the outside plate is bent so as to touch the adjoining plate and can be simply gently levered back.



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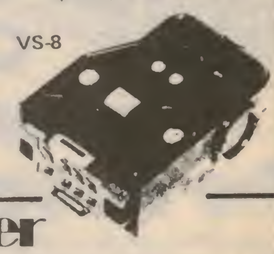

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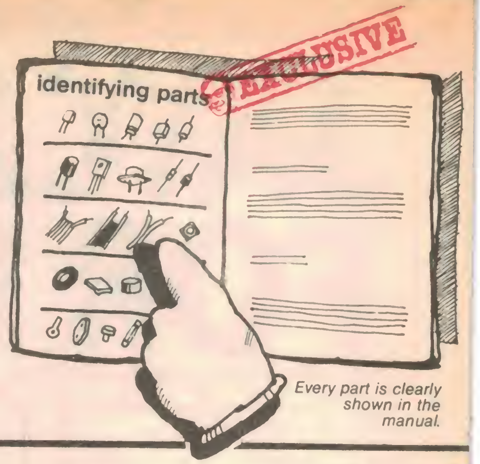

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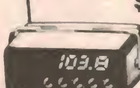

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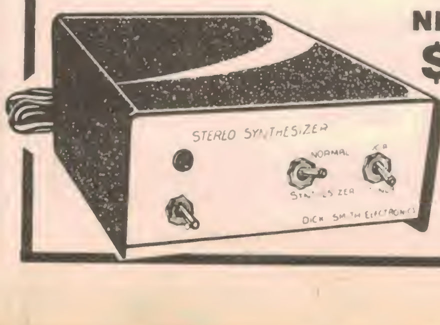

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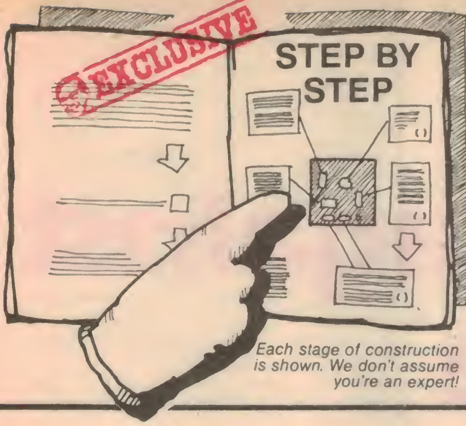
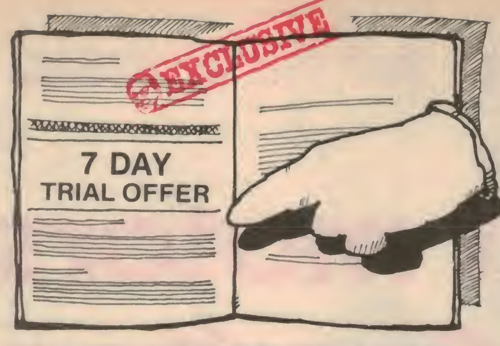
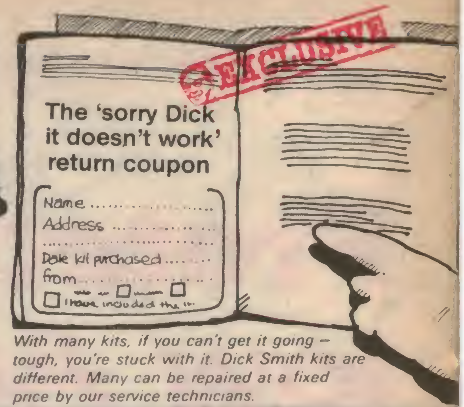


Each stage of construction is shown. We don't assume you're an expert!



Not too sure you can handle it? Relax. If you buy a kit and it is too difficult, just bring it back within a week (still unbuilt!) and get a refund.



With many kits, if you can't get it going — tough, you're stuck with it. Dick Smith kits are different. Many can be repaired at a fixed price by our service technicians.

you can build yourself!

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OUR MOST POPULAR KIT EVER!

“While there have been other single board computers in kit form and there are low cost Basic computers, none can compare with the Super-80 in all-up features or in overall cost.” **Electronics Australia**

was ~~$295~~

$245.00

SAVE $50

K-3600

Pretty impressive words. But when you compare the Super-80, you'll find there is no other machine to compare with it. For $245.00 you are supplied with a full board including, EPROM monitor, 16K of RAM, a relay activated cassette interface, TV modulator (so you don't need to spend hundreds of dollars on a video monitor), and full sized professional keyboard. And that is just the start. Because unlike other "cheap" computers, the Super-80 can expand at low cost in whatever direction you want. Just compare the cost of memory expansion: the Super-80 can be upgraded to a full 48K of RAM for only $59.90, a fraction of the price of memory expansion on other machines. S100 expansion for the Super-80 is only $21.00, no need to spend a fortune on S100 expansion boxes! And with the Super-80 you have full technical and BASIC manuals and the backing of Electronics Australia. Care in the design and instruction manuals means that despite its complexity, the Super-80 is not difficult to build. Professional soldermask PCB and detailed sectionalized instructions makes building the project a rewarding and educational experience for anyone interested in computers.

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Super 80 with EPROM Monitor, 16K RAM,(K-3600) .... **was$295 now $245.00**
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Character Generator (U/L case)(K-3607) ... **was $69.00 now $50.50**
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BASIC manual(B-3602) **was** ....**$14.50 now $9.50**
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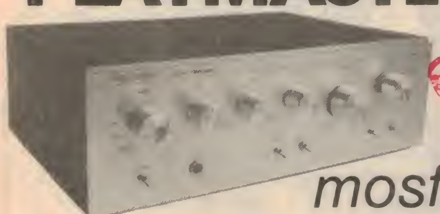
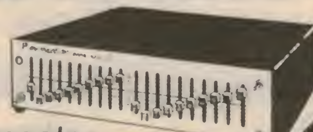
BUILD THEM YOURSELF



Playmaster mosfet amplifier

This superior Mosfet amplifier provides 50W per channel of superb sound. Enough power and facilities to satisfy even the most demanding hifi enthusiast. Yet the cost is around one third of an equivalent commercial unit. Step by step construction manual means you'll have no trouble putting this popular kit together. Facilities are very complete: Full speaker switching, tape monitoring, loudness and mute controls. Your friends will never believe you've built it!! Cat K-3515.

only **$175**

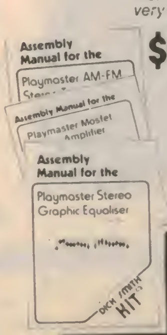


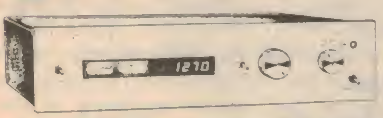
Playmaster graphic equalizer

Improve your sound with this 10 band design. Matches the Playmaster amp and tuner. Step by step instructions make this a very straightforward kit.

$99.50

K-3500





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See page 98 for full address details.

DICK SMITH Electronics
INC IN NSW

DSE/A457/AE

Protect motors against low AC voltage

To urban dwellers, the expression "power failure" has connotations of blown fuses, black-outs or even the more ominous power rationing. The ensuing loss of power is always an inconvenience and, with respect to freezers etc, can be expensive. Another type of power failure rarely seen in cities but relatively common in rural areas is the "brown-out". Surprisingly, the partial power loss of a "brown-out" can be more of a menace than a complete black-out.

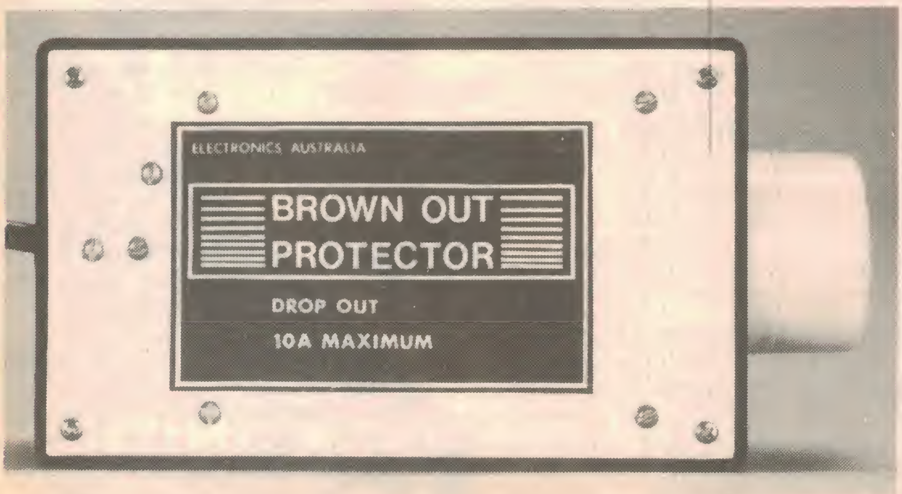
by COLIN DAWSON

The term "brown-out" refers to a reduction in mains voltage which causes incandescent lamps to go dim (hence, brown), television pictures to contract and motors to stall. This rarely occurs in cities but can be quite common in rural areas where fault conditions may go unrepaired for some hours (fallen trees, dead possums partially shorting the lines, etc) or where load conditions cause severe voltage drops at the ends of long distribution lines.

When a brown-out occurs, any induction motor such as used to run a refrigerator, washing machine, freezer or pump is in danger of being burned out if it is switched on while the low voltage condition is present. The reason for this is that while the motor is starting and in the process of coming up to normal operating speed, it draws very heavy current which means very high power dissipation in the windings.

Normally these heavy starting currents are only present for a few seconds and so do not cause any problems. But if the mains voltage is low, the motor will be unable to develop sufficient torque to achieve normal operating speed and will remain in a condition of "high slip" and high power dissipation, leading to eventual burnout.

Some motors are protected by thermal cutouts but even so, the starting winding on single-phase motors can still be burnt out. Whatever the damage, the loss of the motor can be very expensive and inconvenient and the loss of perishable goods in a freezer must also be made good.



The Brown-out Protector automatically trips a relay to disconnect the load whenever the mains voltage falls below a preset level.

We have experienced brown-outs in some areas of Tasmania where the mains voltage went so low that neon indicators in power points were extinquished, ie, the voltage dropped below 50VAC. These conditions, which often lasted hours, would certainly cause the burnout of any refrigerator or pump motor.

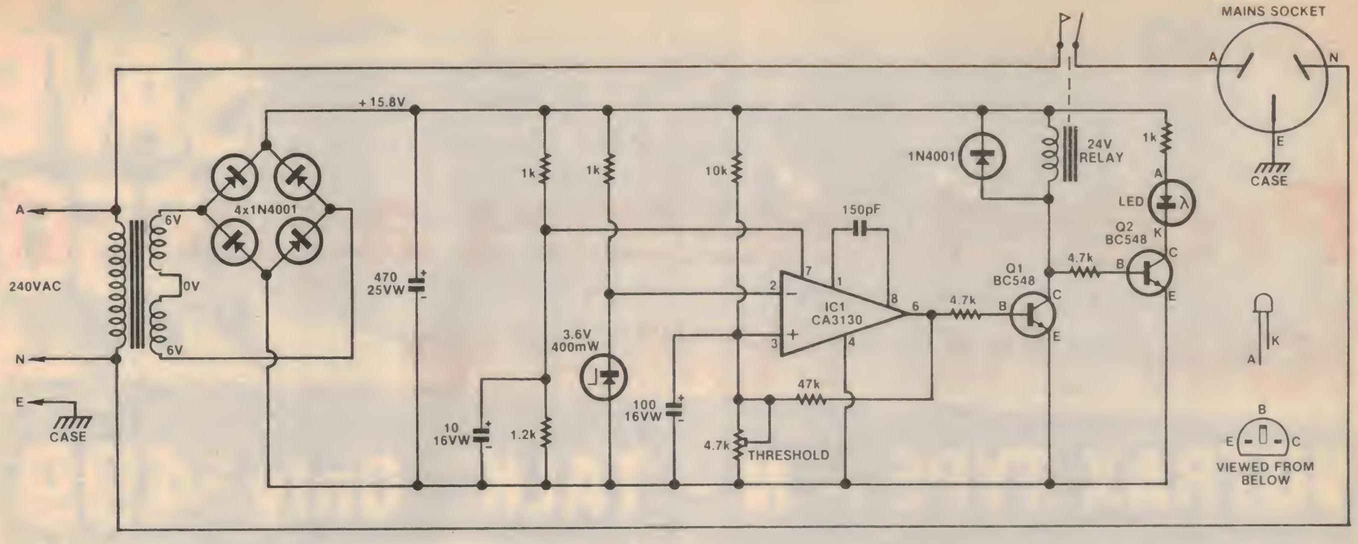
While the householder can disconnect motor-powered appliances whenever a brown-out occurs this would require constant monitoring. After all, a brown-out could easily occur late at night when he is asleep. The consequence is that he could awake next morning to find that the refrigerator motor had burnt out.

The EA Brown-out Protector provides constant protection for any single-phase induction motor, disconnecting power when the mains voltage drops and then reconnecting when voltage returns to normal levels. The cost of this protection is far less than the cost of repair of a typical fractional horsepower induction motor. It may be used with motors rated up to 2kW. The circuitry could also be adapted to switch the contactor for three-phase motors.

If the mains voltage should fall below a preset level, the Brown-out Protector automatically trips a relay and disconnects the load. While ever this condition exists, a LED will be illuminated or, alternatively, a buzzer can sound. The trigger or "drop out" voltage would typically be set at about 220V, but can be set at any voltage between 168V and 227V.

The Brown-out Protector incorporates a relay which controls the mains active line to the load. Provided that the mains voltage is normal, the relay contacts will be closed and power available to the load. When a brown-out is detected the relay contacts will open, disconnecting the active line to the load.

The relay chosen for this project is a Takamisawa VF24HN. Despite its small



BROWN-OUT PROTECTOR

2/PC/-

size, it has a 25A rating on its contacts, which leaves a good margin of safety when used with motors of up to 2kW. The relay has a coil voltage of nominally 24V, rather than the more usual 12V. It is available from Associated Controls, 55 Fairford Rd, Padstow, NSW 2211.

Most readers will be aware that connection of an induction motor to the mains can itself cause a momentary voltage drop. This is evident in the flicker of lamps when a washing machine or airconditioner cuts in. The Brown-out Protector incorporates a delay circuit to compensate for this characteristic while still giving full protection.

How it works

Power for the circuit is derived from a 12V centre tapped transformer feeding a full wave bridge rectifier. The output of the rectifier is filtered by a 470μF capacitor and, when the relay is energised, supplies 15.8V. This rises to about 16.5V when the relay is released. Although the relay coil has a nominal rating of 24V, it will pull in at 14V and works quite effectively at 15-16V.

To detect a brown-out, a CA3130 Fet input op amp is employed as a comparator. A zener regulated 3.6V reference is applied to its inverting input (pin 2) and compared with a sample voltage on its non-inverting input (pin 3). The sample voltage is obtained by means of a two-resistor divider across the supply. Since this supply is provided by a transformer, it must vary in proportion to any changes in the mains voltage, as must the sample voltage.

One of the arms of the divider is a 4.7kΩ trimpot and this is used to calibrate the device. It can be used to adjust the sample voltage for any given mains voltage, which effectively determines the drop-out point. With the mains at 240V, setting the sample at very slightly above 3.6V will cause the comparator to trigger at a relatively high voltage (230V or more). Setting the sample at progressively higher values will cause the drop-out to occur at correspondingly lower voltages. A trigger delay of about one second is provided by a 100μF capacitor connected between pin 3 and ground.

The output of the comparator (pin 6) goes high when the device is triggered. This drives the base of transistor Q1 through a 4.7kΩ resistor. The relay coil forms the collector load of Q1, and has a current drain of about 34mA when it is energised.

Once the Brown-out Protector is triggered, it is essential that it triggers cleanly and completely. It would be unsatisfactory to have the relay chattering when the mains voltage is at the critical level and for this reason the device has been provided with hysteresis. A 47kΩ resistor between the output of the comparator and the non-inverting input gives it a hysteresis of typically 13V. This means that if a drop-out occurs at 220VAC, the device will not reset until the mains voltage rises to about 233VAC.

The CA3130 was selected for use as the comparator because its output, when in the low state, goes fully to ground and thereby turns the BC548 transistor hard off. Many op amps go to 0.6V when in the low state and this would not guarantee turning the transistor off. A disadvantage of the CA3130, however, is that it cannot be operated from a supply voltage of higher than 16V. Since the voltage from the rectifier can be as high as 16.5V, another voltage divider is used to provide an op amp power supply of around 8.7V.

A second BC548 transistor, Q2, is used to drive a LED to provide a warning when a drop-out occurs. Its base is driven from the collector of Q1 which is normally low. In the event of a brown-out, Q1 will be turned off and its collector pulled high by the relay coil. This biases Q2 on and the LED will be activated.

PARTS LIST

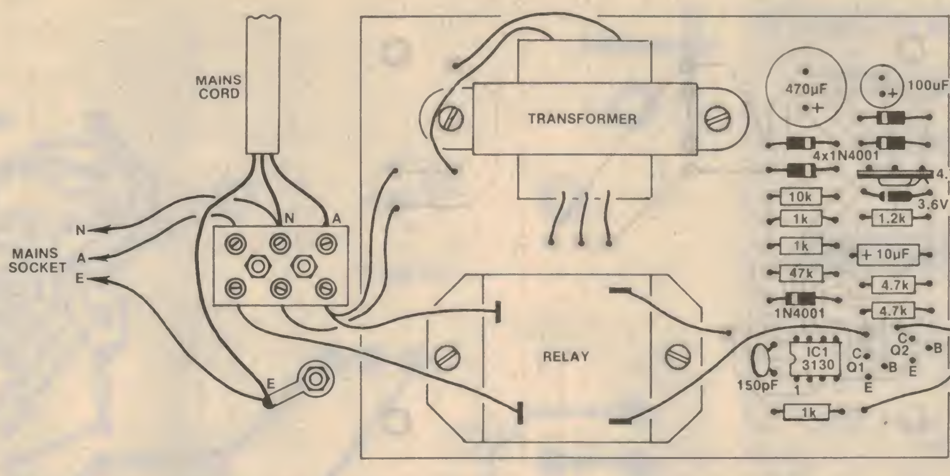
1 24V relay, code VF24HN
1 12V centre-tapped transformer
1 surface-mounting mains socket
1 10A mains cord and plug
1 plastic utility box, 158 x 96 x 60mm
1 printed circuit board, 102 x 86mm, code 83bp3
1 Scotchcal front panel

SEMICONDUCTORS
5 1N4001 diodes
1 3.6V zener diode
2 BC548 NPN transistors
1 CA3130 Fet input op amp
1 LED

CAPACITORS
1 470μF/25VW electrolytic
1 100μF/16VW electrolytic
1 10μF/16W electrolytic
1 150pF ceramic

RESISTORS (¼W, 5%)
1 x 47kΩ, 1 x 10kΩ, 2 x 4.7kΩ, 1 x 1.2kΩ, 3 x 1kΩ
1 x 4.7kΩ 10mm vertical trimpot

MISCELLANEOUS
2 mains cord grommets
1 cable clamp
1 terminal strip (3 way)
Machine screws and nuts
Hook up wire (10A mains-rated where applicable)

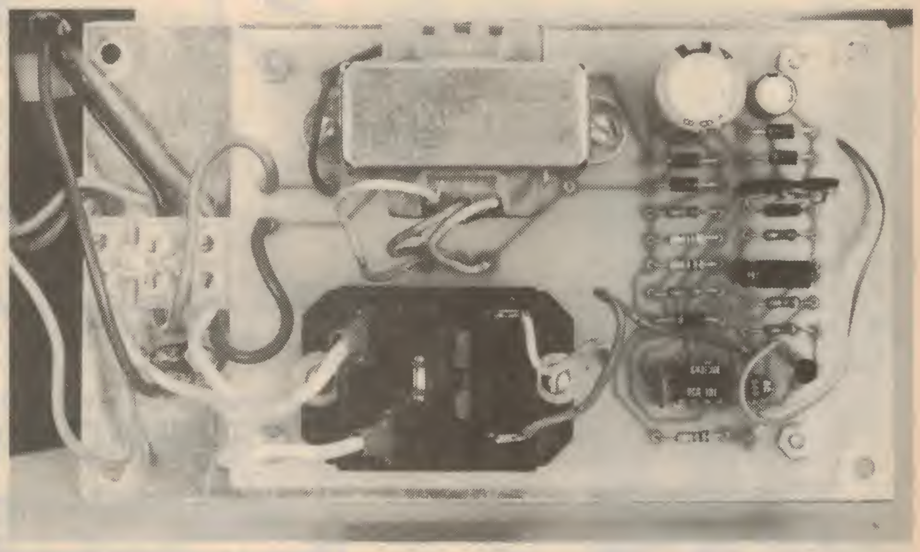


Parts overlay diagram of the Brown-out Protector. Take care with the orientation of polarised components.

Construction

The PCB, coded 83bp3 and measuring 102 x 84mm, was designed to fit into a plastic utility box. It will ultimately be affixed to the lid of the box so the mounting holes should be drilled in the lid of the box at this stage. Don't forget to leave room for the three-way mains terminal block, which will require two mounting holes of its own. Another hole will be needed for the mains earthing point and one for the LED.

The printed circuit board will have to accept a total of eight machine screws, each of about 3mm. Four of these are used to secure the PCB itself and two each are used for the transformer and relay. Check that the screws fit in their respective holes before mounting any components to the board. Also make sure that the holes associated with the mains transformer and relay are large enough to accept the wiring.



View inside the completed prototype. Make sure that you keep all mains wiring neat and tidy and note that mains voltages are present on the PC board.

When mounting the components on the PCB, start with the smallest items. Watch the orientation of the diodes, transistors, IC and electrolytics. Don't forget to include two wires of about 100mm to connect to the LED. At this stage the transformer and the relay can be mounted. We have used an inexpensive M-2851 type transformer, although the PCB has also been designed to accept the "PCB mounting" style of transformer such as Ferguson PL12/5VA. The latter requires no mounting screws – it is held in position by its solder connections. The relay has mounting slots rather than holes and this necessitates the use of washers under the screws. The washers commonly available will probably prove too large in diameter, although this can be overcome by trimming them.

A hole must be drilled at either end of the box to accept a mains cord. Allowing for rubber grommets, these should be about 14mm. A mains socket is mounted over one of these holes and a cord clamp is mounted next to the other (see photo). The accompanying wiring diagram illustrates the correct method of connecting the mains wiring. Be careful not to transpose the neutral and active lines as this is a potentially fatal mistake. Although the appliance will function normally, it can still be "live" when switched off. The colour code for mains wiring is earth – green or green with a yellow trace; neutral – black or blue; active – red or brown. Note that the mains cord, plug, socket and internal wiring should all be rated at 10 amps.

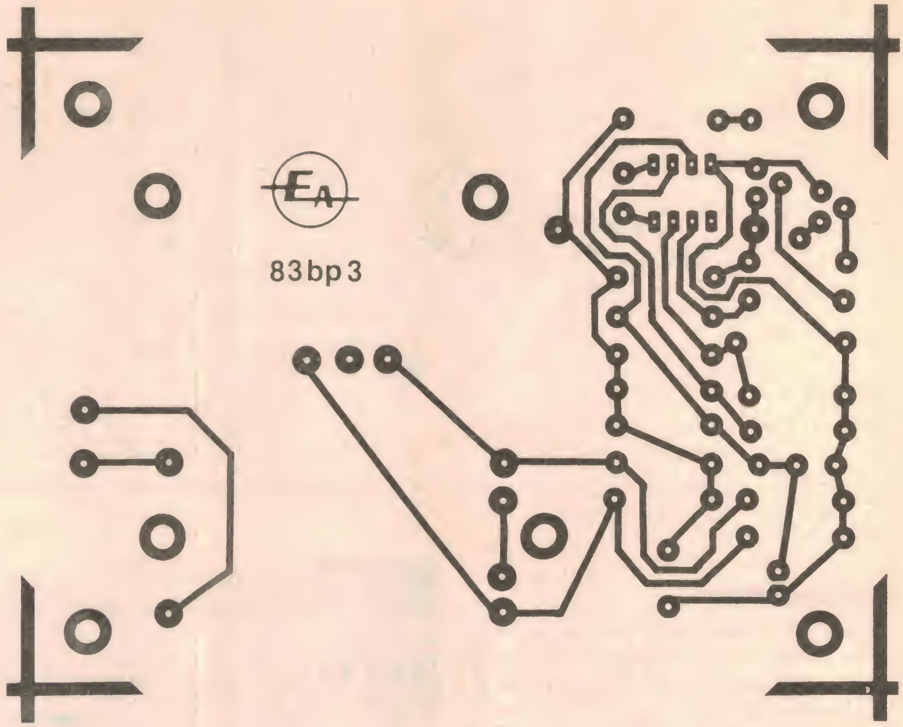
> We estimate that the current cost of components for this project is approximately
>
> **$25**
>
> This includes sales tax.

Make sure there are no points of exposed mains wiring. This means leaving the insulation flush with the terminal block or PCB. Pay particular attention to the relay's mains connections. We used heat-shrink tubing, but a better approach may be to use Utilux connectors, provided that they will fit inside the box you choose.

Solder the connection to the LED and then mount the PCB in place. Construction is now complete and the Brown-out Protector is ready for a test. This should be done without any load connected.

Calibration

Switch the device on and allow it to run for a few seconds. Provided that there are no obvious signs of a problem, the device is ready for calibration. This



Here are actual size artworks for the PCB and front panel.

can be done by either of two methods, the simplest of which is to use a Variac. In this case, the voltage applied to the device is simply set at 220V and the trimpot adjusted until the comparator just triggers. Make any adjustments slowly to allow for the trigger delay and don't handle the PCB while power is on, as mains voltages are present.

Triggering should always occur at the chosen voltage now, with resetting at about 13V above this value. For those constructors without access to a Variac, the second method of calibration only requires the use of a multimeter. This should be set to the lowest DC voltage range which will accommodate 4V, and used to measure the sample voltage at pin 3 of IC1. Adjust the trimpot to the point just before triggering occurs (with a 240V supply). Again, this must be done slowly to allow for the trigger delay.

Take note of the voltage at which the triggering occurs — it may take several attempts to determine this point with reasonable accuracy. Add 9% to this value (240V is 9% higher than 220V), and set the sample voltage to this value. The trigger point should now be 220VAC. Other trigger points can be set in the same way — just calculate the percent difference between 240VAC and the desired voltage and apply this to the sample voltage.

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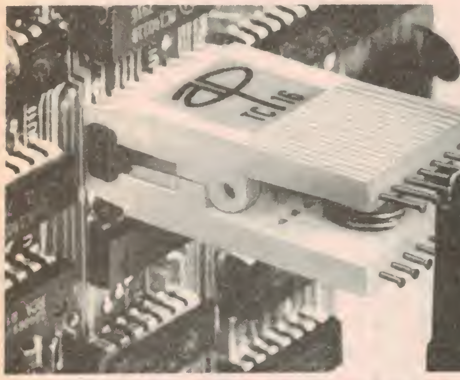


IC TEST CLIPS — We've improved on the original

The Super-Grip II IC Test Clip has a narrow nose for fitting on DIP's on high-density boards. "Open-nose" design also permits probe tip access at DIP leads. New "duck-bill" contacts are flat, won't roll off narrow DIP leads. Contact comb fits between DIP leads, eliminates shorts. New "nail-head" contact pins keep probe hooks from sliding off. Offset pin rows allows probes to hang free on longer top row pins and not interfere with shorter lower row. Sizes to fit all DIP's (TC-14 fits 14-pin DIP etc.). Gold-plated or unplated alloy-770 pin contacts. Simplifies testing, trouble-shooting and QC inspection. Also available with long, headless lead pins for attaching cable connectors.

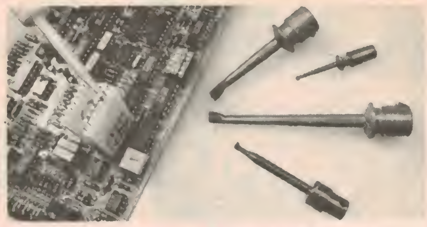
IC Test Clips — AP No.				IC Test Clips
Alloy 770		Gold-Plated		
Std.	Headless	Standard	Headless	
923695	923690-08	923743-08	923739-08	TC-08
923698	923690-14	923739-14	923739-14	TC-14
923700	923690-16	923743-16	923739-16	TC-16
923702	923690-16LSI	923743-16LSI	923739-16LSI	TC-16LSI
923703	923690-18	923743-18	923739-18	TC-18
923704	923690-20	923743-20	923739-20	TC-20
923705	923690-22	923743-22	923739-22	TC-22
923714	923690-24	923743-24	923739-24	TC-24
923718	923690-28	923743-28	923739-28	TC-28
923720	923690-36	923743-36	923739-36	TC-36
923722	923690-40	923743-40	923739-40	TC-40
923724	923690-48	923743-48	923739-48	TC-48
923726	923690-64	923743-64	923739-64	TC-64

LOGICAL CONNECTIONS

A P Logical Connections are a Test Clip/Jumper Assembly combined. They are ideal for microprocessor-to-logic analyzer connections. The Test Clip end is a pair of single-row socket connectors attached to the pins of a Super-Grip II Test Clip. The remote end is a DIP connector. Connectors are molded onto the 18" color-coded flat ribbon cable. Probe access holes in backs of all connectors. Factory tested.

LOGICAL CONNECTION (Test Clip and Jumper)		JUMPER ONLY (No Test Clip)
End	AP No.	AP No.
With DIP Plug	923884-16	922594-16
	923884-24	922594-24
	923884-40	922594-40
No DIP Plug	923880-16	922590-16
	923880-24	922590-24
	923880-40	922590-40

Suffix denotes No. of pins.



PROBE-IT Plunger-Actuated Probes

For hands-free testing, press caps to extend hook contact, hook it onto lead or wire under test and release it. Select from 4 sizes: Micro (1.63"), Mini (2.19"), Standard (2.38"), and Maxi (3.56"). Solder any length of stranded hook-up wire to contact under cap.

AP No.	Color Dash Code	Probe-it Model	Qty/Pkg.
923830-	Rd,Bk,Bu,Gn,Yl,Wt	Micro	2
923835-	Rd,Bk,Bu,Gn,Yl,Wt	Mini	2
923840-	Rd,Bk	Standard	2
923845-	Rd,Bk	Maxi	2
923848	(One ea. of 6 colors)	Micro	6
923850	(One ea. of 6 colors)	Mini	6

BREADBOARD JUMPER WIRE KIT

350 wires cut to 14 different lengths from 0.1" to 5.0". Each length is color coded and segregated in convenient plastic box. Leads are stripped 1/4" and bent 90° for easy insertion. Wire is solid, tinned 22-gauge copper with PVC insulation. **JK1 Wire Kit . . 923351**

JUMPER WIRE PACKAGES

Shown above: individual packages with all wires same length and color in each package.

AP No.	Length (in.)	Color	Qty/Pkg.
923345-01	0.1	(bare)	200
923345-02	0.2	Red	200
923345-03	0.3	Orange	200
923345-04	0.4	Yellow	200
923345-05	0.5	Green	200
923345-06	0.6	Blue	200
923345-07	0.7	Violet	150
923345-08	0.8	Gray	150
923345-09	0.9	White	150
923345-10	1.0	Brown	100

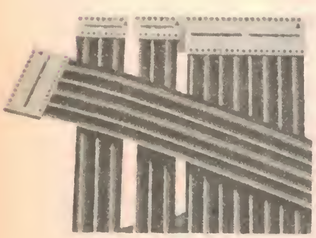
AP No.	Description
922576-20	20-pin conn.
922576-26	26-pin conn.
922576-34	34-pin conn.
922576-40	40-pin conn.
922576-50	50-pin conn.
922578-20	20-pin switch
922578-26	26-pin switch
922578-34	34-pin switch
922578-40	40-pin switch
922578-50	50-pin switch

INTRA-CONNECTOR and INTRA-SWITCH

Connector mates in-line with standard .1" x .1" dual-row socket connectors & headers. Right-angle pins permit probing or daisy-chaining. Intra-Switch permits in-line, on-off switching to test individual circuits. Switches actuated with pencil or probe tip.

DIP JUMPERS

DIP jumpers fit standard DIP sockets. Ideal for jumpering within PC boards; between boards, backplanes, and motherboards; I/O signals, etc. Connectors molded onto cable for optimum strain relief; factory tested; probe access holes on backs. Conductors: 28 AWG. Color-coded cable uses 10-color sequence.



Dip Jumper — Connector on one end	
AP No.	No. Pins
924102-36	14
924112-36	16
924122-36	24
924132-36	40

Suffix in AP No. is length (-06 = 6 in.)

Connector on both ends	
AP No.	No. Pins
924106-06	14
924106-12	14
924106-18	14
924106-24	14
924106-36	14
924116-06	16
924116-12	16
924116-18	16
924116-24	16
924116-36	16
924126-06	24
924126-12	24
924126-18	24
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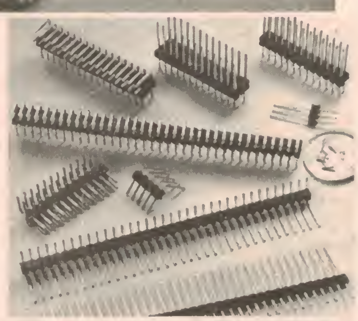
924126-36	24
924136-06	40
924136-12	40
924136-18	40
924136-24	40
924136-36	40



AP No.	Headers	No. Rows
929974	Female	1
929975	Female	2
929834-01	Male, straight	1
929836-01	Male, straight	2
929835-01	Male, rt. angle	1
929838-01	Male, rt. angle	2

MALE AND FEMALE HEADERS

Molded-in, straight and right angle male headers have 36 posts per row. They are stackable to make up matrices of .025" sq. posts on PC boards or to use as patchboards for discrete connections. All mate with female connectors on .100" spacing. Posts extend .235" and .100" beyond .100" sq. header for wire wrapping and soldering. "Break to row length" feature. Posts are alloy 770, unplated. Female headers also are stackable and mate with matrices of .025" sq. or round posts on .100" centers. 36 "tuning fork" contacts per row are molded into header strip with .100" solder tails for PC board mounting or cable attachment. "Cut to row length" feature. Contacts are alloy 770, unplated. Dual-row headers are ultra-sonically welded at factory.

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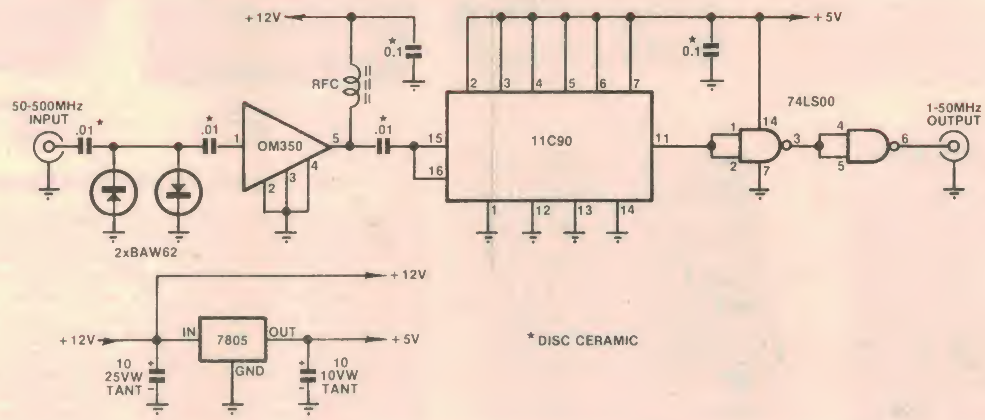
Circuit & Design Ideas

Interesting circuit ideas from readers and technical literature. While this material has been checked as far as possible for feasibility, the circuits have not been built and tested by us. As a consequence, we cannot accept responsibility, enter into correspondence or provide constructional details.

500MHz prescaler for digital frequency meters



Many older commercial frequency meters are incapable of measurements above 50MHz but this is no reason to scrap them. With the addition of the prescaler circuit from the EA 500MHz Frequency Counter (December 1981), they can be given a further lease of life.

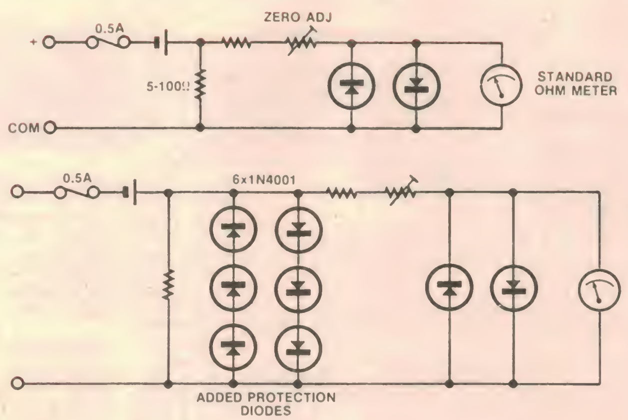
The circuit uses the 11C90 as a 10:1 divider preceded by the OM350 hybrid amplifier to increase the sensitivity. The 74LS00 buffers the output while the 7805 regulator supplies the 5V rail to run the 11C90 and 74LS00 from the 12V rail.

The RF choke is wound on a 13mm balun core with six turns of 22B&S enamelled copper wire.

In use, the measured frequency will be ten times that displayed on the counter readout.

P. O'Connell,
Oatley, NSW.

Burnout protector for ohmmeter ranges



Analog multimeters which are used for general purpose electrical testing are often damaged by having 240VAC mains voltage accidentally applied to the low "ohms" ranges. While the meter movement is usually protected from electrical damage by series resistors and shunt diodes, the "ohms" shunt resistor is usually vaporised in spite of any fuse which may be fitted.

This usually results in carbon soot being deposited all over the inside of the multimeter case and is often accompanied by damage to the switch contacts and PCB tracks. If six diodes are added as shown, only the fuse will be blown. If the meter does not have a fuse, it may be added in series with the external positive lead inside the case if space permits.

R. Pointing,
Redbank Plains, Qld.

Loudspeaker protection for high-power amps

A problem has come to light where the EA loudspeaker protector is used with high power amplifiers such as the Playmaster 300W amplifier described in May, June and July 1980. Because of the very high DC supply rails the resultant arc drawn by the relay contacts under a DC fault condition is self-sustaining and can burn out the loudspeakers. The cure is to connect the unused contact of the relay to 0V. The arc will then blow the supply fuses and thus protect the speakers.

This cure can be applied to any loudspeaker protection circuit using a relay with change-over contacts. The only proviso is that the moving contact of the relay must be connected to the speaker load rather than the amplifier output. The modification is not necessary for amplifiers with supply voltages of less than ±50V.

Another method, used by some high-power amplifier manufacturers, is to place a magnet near the relay to quench the arc.

P. Allison,
Summer Hill, NSW.

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Current limiting for the VK Powermate

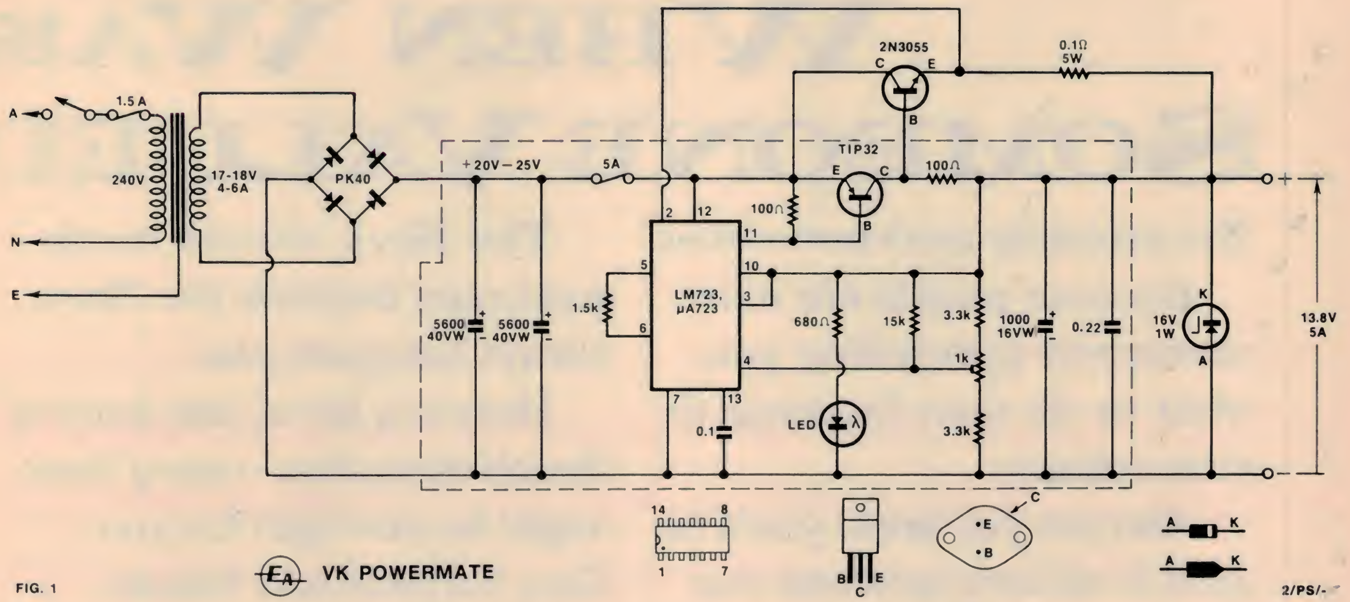


FIG. 1

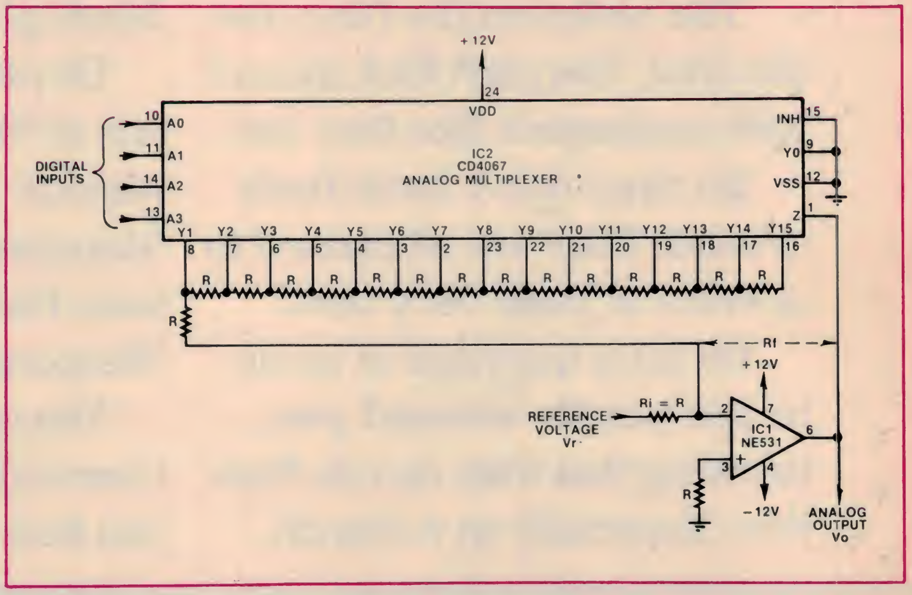
This simple modification to the "VK Powermate" (EA May 1978) provides a protective current limiting function. The modification involves the addition of a resistor, a link on the printed board, and an extra wire.

The additional circuitry uses the current sense/limit transistor inside the 723 regulator, and a current sensing resistor. The value of this resistor is chosen to suit the current limit required, eg, 0.1Ω for 6A or 0.12Ω for 5A. Thus modified, the power supply will withstand a brief short-circuit on the output, but not a sustained one. This is because the dissipation of the output transistors increases substantially.

In detail, the additions should be made as follows: (1) Mount the 0.1Ω resistor close to the output transistor. (2) Remove the wire from the emitter of the output transistor and connect the 0.1Ω resistor in series with this lead and the emitter. (3) Fit a wire link, under the printed board, between pin 10 and pin 3 of the 723 regulator. (4) Connect a wire from pin 2 of the 723 regulator to the output transistor emitter connection.

E. Rodda,
Marion, SA

Analog multiplexer and op amp D-A converter



This simple low-cost digital-to-analog converter uses just one operational amplifier and an analog multiplexer to convert a four-bit digital input into an analog output. Cascading an additional 16-channel analog multiplexer will extend the input digital word length of the D-A converter to eight-bits. The accuracy and the stability of the converter depend mainly on the accuracy of the resistors and stability of the reference voltage.

Op amp IC1 operates as an inverting amplifier with a weighted resistor switching network connected in its feedback path. The 16-channel analog multiplexer (made by RCA) switches the resistor network in response to the four-bit digital input on pins 10 to 13. A four-bit input with decimal equivalent N causes IC2 to provide a feedback resistance of NR.

As an example, consider a four-bit input 0101, whose decimal equivalent is N = 5. Using, for simplicity, a reference voltage of $V_R = -1$ volt, the circuit produces an analog output of $V_O = -5(-1)V = +5V$.

Op amp NE531 (made by Signetics) offers a high slew rate for high-speed operation. The circuit may be used as a programmable-gain-control amplifier whose desired gain can be set by thumbwheel switches. In addition, by interchanging input resistor R and multiplexer IC2, the circuit can serve as a programmable attenuator.

"Electronics," August 25, 1982.

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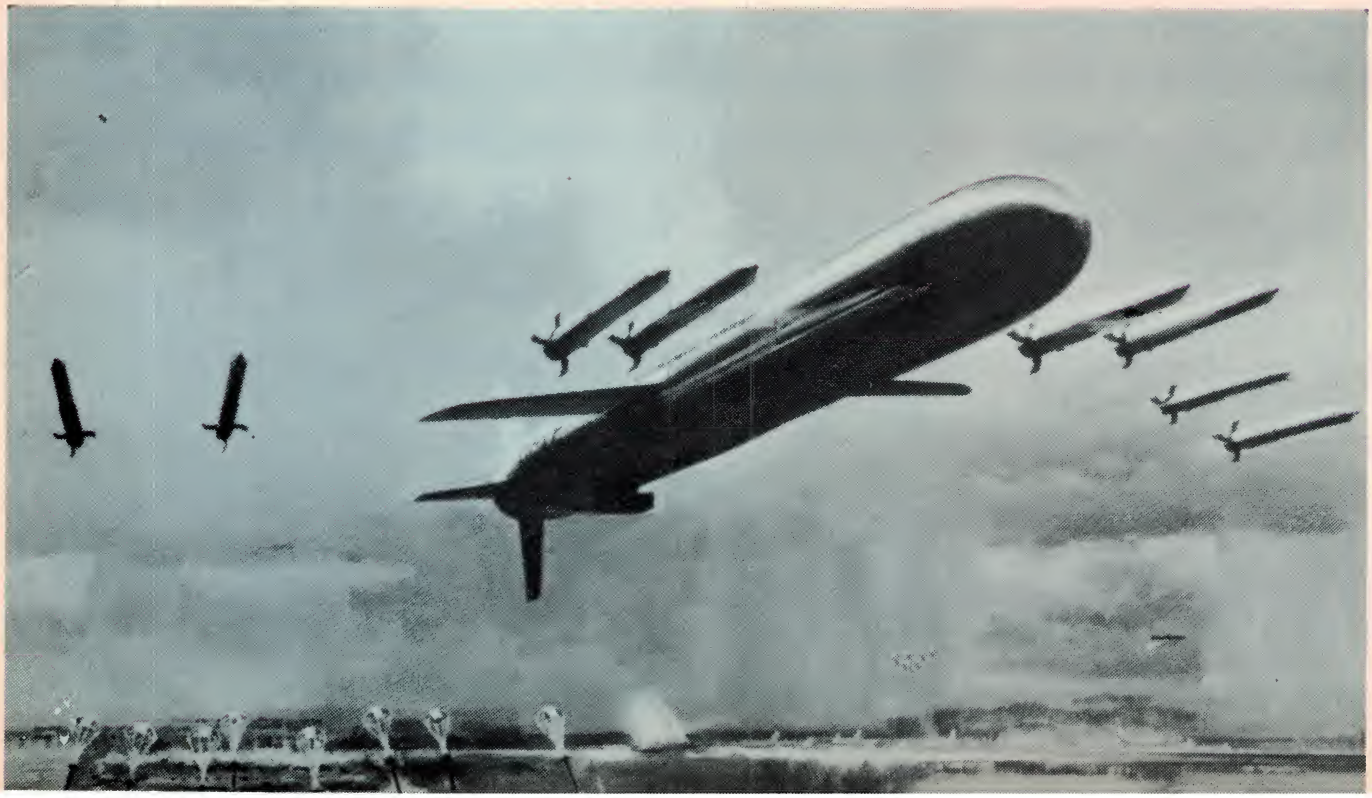
SMART MISSILES

New generation "smart" missiles have made pushbutton warfare a reality. With names like Exocet, Sidewinder and Seawolf, they're small and cheap — and deadly accurate.

by ED EDELSON

IT WAS A SHOT heard round the world. Last May 4, as the British fleet closed in on the Falkland Islands, an Argentine Super Etendard jet fired a single Exocet missile at the British destroyer Sheffield, some 30km away. Using a sophisticated inertial-guidance system and radar, the Exocet skimmed just above the waves and just below the speed of sound toward the ship. The missile gave only a few seconds' warning between the time it was sighted and the moment it hit. In minutes, the midship section of the Sheffield was an inferno and 34 British seamen were dead. In hours, the ship was abandoned and sunk.



RADAR-GUIDED Harpoon missile (above), made by McDonnell Douglas Astronautics, can be launched from aircraft, surface ship, or submarine, and has a range of 90 kilometres. It is an anti-ship missile similar to the French-made Exocet, but has a 230kg warhead vs. 160kg for the Exocet (which was enough to sink the British destroyer Sheffield in a single blow). The Tomahawk (left) is a medium-range (460 kilometres) air-to-surface missile guided by an infrared image seeker in its nose. Now under development by General Dynamics, it can be used against ships or land targets. Here the missile attacks a runway with cratering sub-munitions.

The sinking of the Sheffield was the most dramatic event in a few weeks of combat that showed just how modern warfare has been revolutionised by "smart missiles" – weapons that can change course to track down an enemy target relentlessly by using a host of electronically controlled sensing and guidance systems. In the Falklands, the Argentine navy suffered its greatest loss when a British submarine used Tigerfish torpedoes, guided by signals sent through wires that reeled out behind them, to sink the cruiser General Belgrano. When the British gained a beachhead on the Falklands, they used radar-guided Rapier missiles to fight off Argentine air attacks.

Military analysts were equally impressed with the role played by smart missiles in the Israeli invasion of Lebanon. Israeli aircraft used Shrike missiles that homed in on enemy radar beams to knock out the Syrians' surface-to-air missiles. They swept Syrian fighters from the sky with heat-guided Sidewinder missiles.

In little more than a month, the world had seen an impressive – appalling, to some – display of missile-guidance technologies. How do these smart missiles work? Though some specifics are classified, the general principles are available for the asking – a sure sign that weapons makers worldwide are working at the same level of technology. And the technology moves ahead inexorably as engineers try to turn this year's invulnerable weapon into next year's sitting duck. It's a battle of measure, countermeasure, and counter-counter measure that has been waged for more than a decade.

Smart missiles were causing a basic change in tactics at least as early as the 1970's, during the Vietnam War. US jets suffered heavy losses from anti-aircraft batteries as they tried to knock out key bridges with standard "iron bombs". Then came Pave Way laser-guided bombs. American jets centred a laser beam on the exact point they wanted to hit. A sensor in the nose of a bomb picked up the reflected laser light, and steerable fins guided the bomb to within eight metres of the target. The accuracies made it possible to destroy in one or two sorties a bridge span that might otherwise have required dozens.

Although laser-guided smart missiles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SMART MISSILES . . .

are still an essential part of the modern arsenal, they weren't much in evidence either in the Falklands or in Lebanon. The major targets in those two wars were ships and aircrat, which are best attacked by radar- and heat-guided missiles.

The Exocet, for example, found the Sheffield by radar guidance — first from the aircraft that launched it, then from its own on-board radar system. When the Exocet is fired, its onboard computer is given data about the target's range and bearing. It has an inertial-guidance system that uses a gyroscope and accelerometers to keep it on course and a radar altimeter to hold it at the desired altitude above the surface — generally, just high enough so it doesn't smash into a wave. Data from the guidance system goes to the on-board computer, which steers the missile by controlling its moveable tail fins. At about 16km from its target, Exocet turns on its own small radar set, finds the target, and locks onto it. Essentially the same kind of guidance system is used by the major US anti-ship missile, the Harpoon.

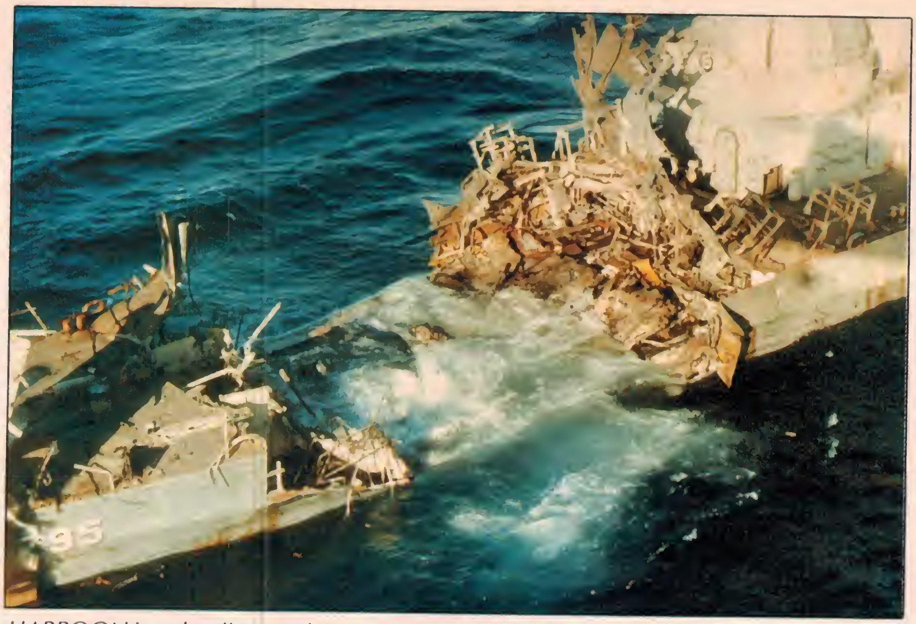
The Exocet is smart, but it isn't brilliant. It worked against the Sheffield, but a second Exocet that was launched at the same time against another British vessel missed. It was decoyed by chaff — strips of metal foil that have been used since World War II to create confusing radar profiles. When the Argentines fired an Exocet in an apparent attempt to sink the aircraft carrier Hermes, they hit the Atlantic Conveyor, a container ship, instead.

Lessons from Lebanon

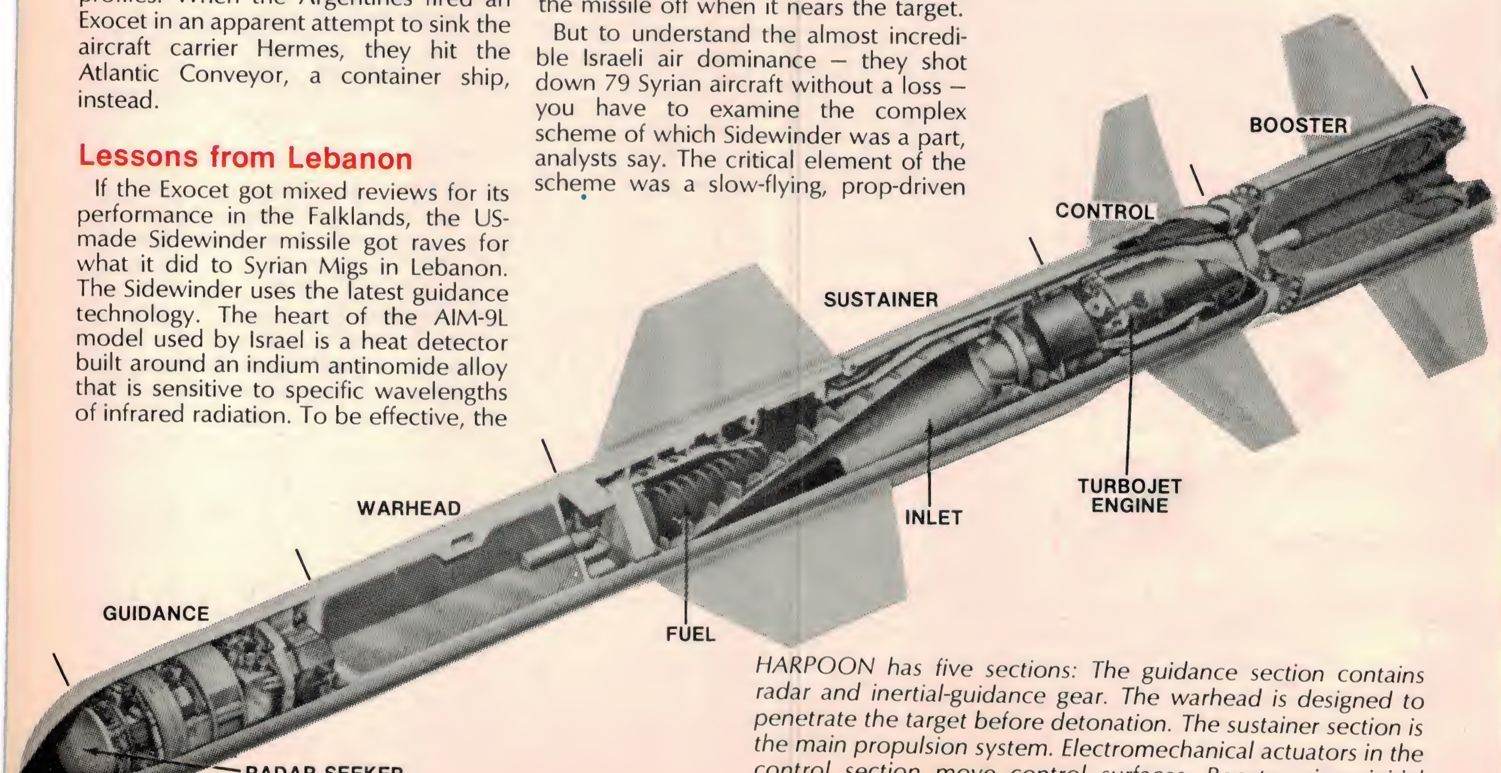
If the Exocet got mixed reviews for its performance in the Falklands, the US-made Sidewinder missile got raves for what it did to Syrian Migs in Lebanon. The Sidewinder uses the latest guidance technology. The heart of the AIM-9L model used by Israel is a heat detector built around an indium antinomide alloy that is sensitive to specific wavelengths of infrared radiation. To be effective, the detector must be cooled to below minus 100°C. The AIM-9L uses a refrigerator that keeps the sensor cold by boiling away liquid hydrogen. Older models of the Sidewinder had to be fired from behind the target aircraft; they would literally fly up the tailpipe by detecting heat from the jet exhaust . The AIM-9L model can be fired head-on, because it can sense exhaust gases as they flare away from the tailpipe. (The sensor is so effective that it can detect heat from the friction of air molecules on a wing, engineers boast.) A proximity fuse sets the missile off when it nears the target.

But to understand the almost incredible Israeli air dominance — they shot down 79 Syrian aircraft without a loss — you have to examine the complex scheme of which Sidewinder was a part, analysts say. The critical element of the scheme was a slow-flying, prop-driven aircraft, Grumman's E-2C Hawkeye. The Israelis have four of them, all loaded with the most modern radar-detection and analysis equiment. The E-2C can track low-flying aircraft at a range of more than 300km using its sophisticated, computer-orchestrated radar system. It can also detect radar emissions from hundreds of airborne or ground-based sources in a 650km radius.

The first step toward Israel's victory in the air was to knock out Syria's SA-6 surface-to-air missiles. They used an in-



HARPOON is a deadly anti-ship missile, as this view graphically illustrates. The missile has been selected for use by Australian forces.



HARPOON has five sections: The guidance section contains radar and inertial-guidance gear. The warhead is designed to penetrate the target before detonation. The sustainer section is the main propulsion system. Electromechanical actuators in the control section move control surfaces. Booster gives initial thrust.

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SMART MISSILES . . .

genious method. First, they sent over unpiloted drones to attract the attention of the SA-6 batteries. They swiftly identified the radar frequencies that the Syrians used to track the drones. Radar homing systems on US-made, air-launched Shrike missiles were set to those frequencies, and the Shrikes followed the radar beams to destroy the SA-6 batteries.

When Syrian Migs took off to challenge Israel's American-supplied F-15 and F-16 fighter jets that carried the Shrikes, they were tracked almost from the end of the runway by the E-2C's radar. The E-2C also pinpointed the frequencies that the enemy aircraft used to find their targets. Those frequencies were then jammed, blinding the enemy. Finally, the Israeli jets launched their Sidewinders, which were guided to the Migs by their IR sensors. "The Sidewinder was just part of the end game," says William B. Farnsworth of Raytheon, which makes the missile. "The real thing was the command and control aspects of the battle."

Antitank missiles

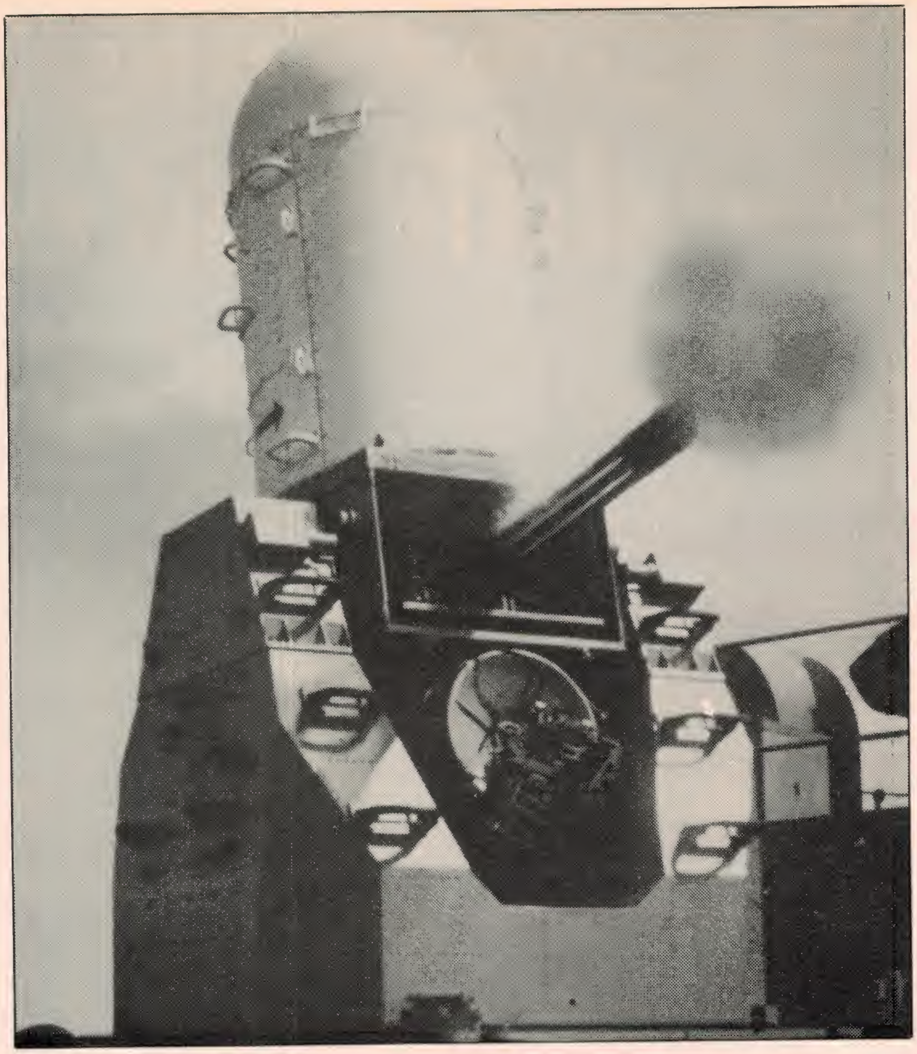
A different version of the story is being told on the ground, where the fight pits foot soldier against tank. Formerly, tanks held a clear edge. "Our object is for a very few men with very sophisticated weapons to take on a whole tank battalion and stop it," says William C. McCorkle of the Army Missile Laboratory at the Redstone Arsenal in Alabama.

Israeli tank losses in the 1973 war with Egypt made it appear that foot soldiers could fight tanks on better-than-equal terms. Scores of Israeli tanks were knocked out by wire-guided missiles fired by Egyptian infantrymen. Correspondents remember battlefields littered with burned-out tanks and the leftover missile wires.

In Lebanon, though, Israel changed its tactics slightly. Instead of having tanks spearhead the attack, Israel is said to have sent in ground soldiers ahead of them. They cleared the battlefield of the Syrian troops who carried the antitank missiles. Then the tanks rolled forward.

Israeli tactics took advantage of the major weakness of smart antitank missiles. Unlike "fire and forget" missiles, such as Exocet, whose launch crew can be long gone when the missile hits home, today's antitank missile is effective only if someone has the target in his line of sight.

Many of the current generation of antitank missiles get their instructions over wires that reel out behind them. In the original versions, infantrymen used joy sticks to guide the projectile to the target. Newer versions, such as the US Army's TOW and Dragon, have a guidance system that uses a heat source



LAST DITCH DEFENCE — Phalanx antimissile system from General Dynamics. This very effective ship-mounted weapon uses a radar-guided Gatling gun to blast incoming missiles at a rate of 3000 rounds per minute. Its ammunition is more potent than most because the core of each round is made of depleted uranium for maximum impact. The system is to fitted to several RAN ships.

on the missile to keep it on course. The soldier who launches the missile keeps his sight cross hairs on the target. An infrared sensor in the launcher follows the heat source on the missile and thus knows if it wanders off course. Then computer-generated commands, which reach the missile through two wires that reel out behind it, fire side-thrusting rockets to put it back on track.

Newer antitank missiles, such as the air-launched Hellfire and the ground-launched Copperhead, use lasers to zero in on the target. A sensor in the head of the missile detects laser light reflected off the target.

The key, of course, is to keep the laser beam aimed at the target. One way to do that is to mount the laser on a helicopter. The army is also working on the Ground Laser Locator Designator, which foot soldiers could use. In the case of Hellfire, a helicopter could fly over the battlefield and launch the missile. Copperhead could be launched by a tank several kilometres away from the target. The laser designator would be switched on at the last moment, giving the missiles the laser spot they need to hit home.

On the horizon is a new generation of wire-guided missiles using fibre optics. These missles would reel out thin glass threads capable of carrying enormous volumes of data. A soldier could launch the missile at a target that is out of sight. As Hughes Aircraft, which is working on fibre-optic missiles, describes it: "Everything the missile 'sees' through the camera on its nose — tanks, troops, command posts — zips through the plastic-clad glass fibre to the launcher's display. The glass thread serves as a two-way street as the computer takes over, snapping steering commands back up to the missile, veering it to the selected target."

Along with this constant updating of attack missiles, there is constant work on missiles to destroy missiles or make them ineffective. For example, a helicopter that wants to launch Hellfire — or its enemy equivalent — puts itself in range of small and portable ground-to-air missiles. The British in the Falklands

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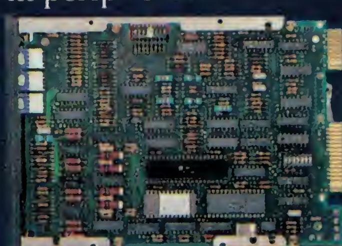

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SMART MISSILES . . .

THE SEA DART missile was carried by the ill-fated Sheffield. Made by British Aerospace, it was successful against Argentine aircraft but not against Exocet.

had Rapier, which uses a sophisticated radar guidance system, and the shoulder-held Blowpipe, guided by a joy stick. The US Army has the radar-guided Roland and an infrared-guided anti-aircraft missile, Stinger, that one soldier can fire.

Many analysts believe that if the Sheffield had been armed with the British-made Seawolf antimissile, the ship might have been saved. The Seawolf has radar designed to detect any incoming missile, even a sea-skimmer like Exocet, in time to shoot it down. Another antimissile weapon used on ships is the Phalanx, a modern version of the Gatling gun. Phalanx is a defence of last resort. Its multiple barrels throw up a wall of metal, firing 3000 rounds of 20-millimetre ammunition a minute.

The ultimate question is whether defence measures can keep up with the steady improvement in attack missiles. The answer you get often depends on whether you ask the people who are working on defence or those working to make the attack more deadly. Designers at McDonnell Douglas, maker of the Harpoon, think they have a weapon that puts any defence to a hard test. The Harpoon's guidance systems are continuously being updated. For example, the first versions were programmed to pop up from the surface and dive into an enemy ship at the last moment for better hull penetration. The latest models stay at surface level "for better survivability," says Bruce Craddock of McDonnell Douglas. "It's so low that it's difficult for a radar to track."

Maverick, an air-to-surface missile made by Hughes Aircraft Co, is another example of a smart missile being made ever smarter. The original version, now in use by the US Air Force, is guided by television. A TV camera in the nose of the missile produces a picture on a television screen in the cockpit of the aircraft. The pilot picks out the target, centres cross hairs on it, and launches the Maverick. Its microprocessor guides the missile to the spot by moving the missile's fins.

The limitation of the TV-guided Maverick is that it can be used only in daylight and in clear weather. A new version under development uses an infrared imaging detector, which produces images on a display screen. The pilot picks out a target, such as a tank, by looking for its distinctive heat signature.

If the infrared Maverick works as planned – there are Congressional critics who say it won't – it will find its way in the dark and in any weather. Robert Knowles, technical manager for Maverick, remembers one night-time test. "We made a launch near midnight," recalls Knowles. "I was watching the missile broadcast imagery to the ground all night. When I drove out on the range in the dark, I drove past the target tank several times before I saw it. Can you imagine what it would be like to be a tank commander and know you could be hit by a missile fired by an aircraft several kilometres away when you can hardly see the ground in front of you?"

The round of measure, update, and countermeasure goes on. To give another example, Aerospatiale, the French company that builds the Exocet, is working simultaneously on the next generation of Exocet and, in collaboration with a second company, on a weapon to counter the Exocet. The counter-weapon would be launched vertically, lock on the missile, then whip across the water to destroy it.

And, of course, for every countermeasure there is a counter-countermeasure. The military and its suppliers won't talk about details of the technology, but they sometimes describe their results. Craddock, for example, says that the Harpoon has been flown "against all types of countermeasures, and the success rate is 90%."

Meanwhile, the marketing of smart missiles has added an unsettling element to international relations. Industry sources say that more than 20 nations have bought Exocet, for example. Marketing tactics can be amazingly similar to those used for more innocuous machines. If you buy this year's model of the Harpoon, for instance, you get a 36-month warranty, up from 24 months for the older model. A purchaser can also get a service contract, exactly like the one you can buy for your refrigerator. The difference is that this appliance sinks ships and kills people.

HEAT-GUIDED TOW antitank missile, made by Hughes Aircraft Co., reels out wires in flight to keep it in touch with a computer in the launcher. Range is 3.6km. An infrared sight lets it see through darkness, haze and smoke.

Measures voltage, current & resistance

An easy-to-build 3½ digit multimeter

by PHILIP WATSON

A digital multimeter is a very attractive piece of equipment which most experimenters aspire to from time to time, either as a ready-made device, or as something they intend to build when they find a suitable design. Here is a project, in kit form, which should allow any such enthusiast to get on with the job without further procrastination.

Over the last 12 months we have described a number of meters of various kinds, all featuring 3½ digit LCDs (Liquid Crystal Displays). These included a thermometer (February 1982), a capacitance meter (March), a dwell-tacho meter (May), a heart rate monitor (July), and a pH meter (December).

While all these systems were being developed and presented we were aware that many readers wanted to see a multimeter design along the same lines. Unfortunately, it was difficult to come up with a design which, while offering all the usual features, could be built at a price substantailly less than the retail price of a ready-made and tested unit. .

More recently, the situation changed somewhat. We were made aware of a complete kit of parts for a digital multimeter, packaged by the English firm Lascar Electronics Ltd and distributed in Australia by Jaycar Pty Ltd. Jaycar made a sample kit available to us with the suggestion that we build and evaluate it. The price of the kit from Jaycar is $45.00.

The circuit is designed to provide four ranges each of DC volts, AC volts, DC current, AC current, resistance, and a diode test. The four ranges are the same in each case; 2, 20, 200, and 2000 volts, milliamps, or kilo ohms. All functions operate from the one pair of input terminals and are selected by combination settings of three switches. The multimeter is housed in a black plastic case measuring 110×80×33mm (L×W×D), and is powered by a 9V, type 216 battery.

Note that, although the circuit will theoretically measure up to 2000V, the makers specify a limit of 500V, no doubt due to limitations of the overall insulation.

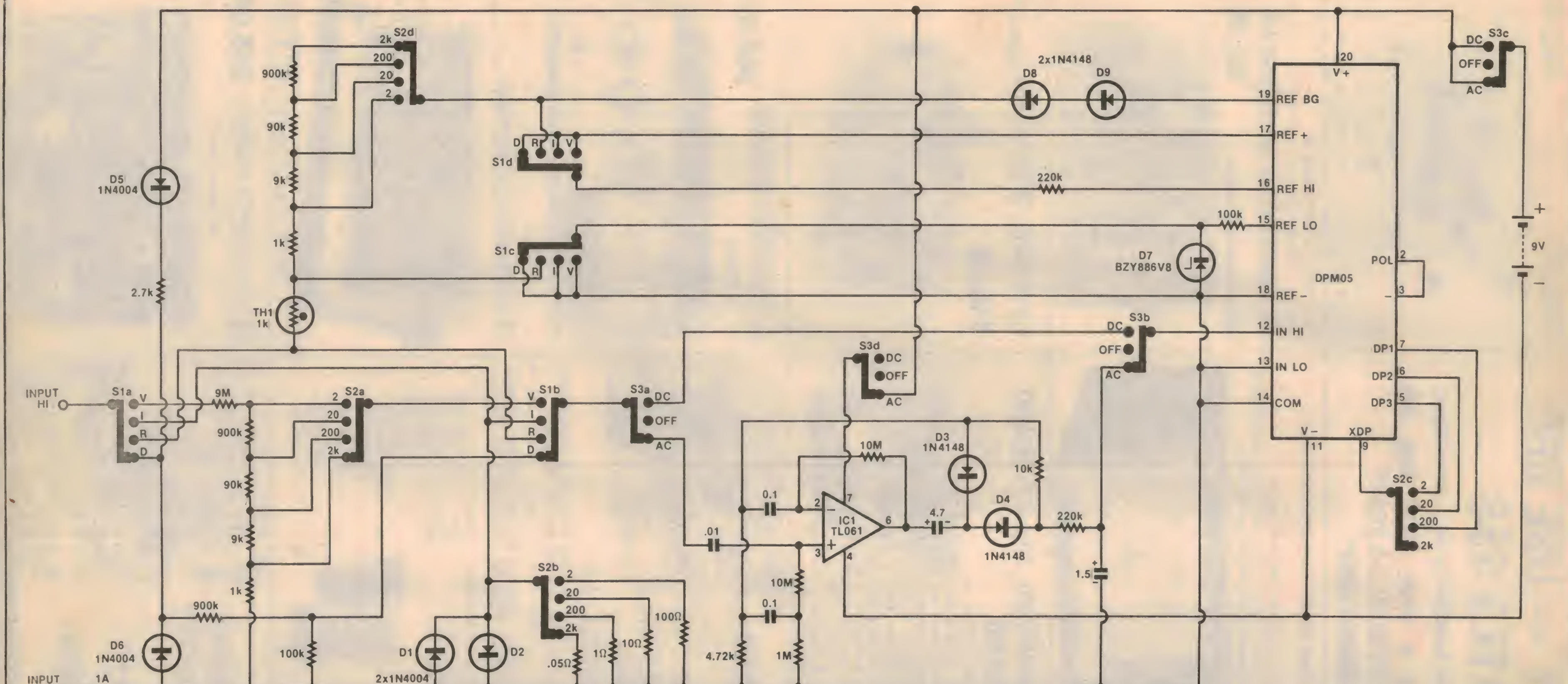
The kit, as supplied, consists of three packages; the makings of two modules and a pair of test leads. There is also an instruction sheet. The two modules are a readout module, DPM05, and "conditioning" module, DP2010 (1% basic accuracy).

The DPM05 readout module is identical with that used for the pH meter described in our December, 1982 issue. Basically, it is a 3½ digit LCD, driven by a 7126 analog/digital converter, a 4070 quad exclusive OR gate, and sundry minor components. It has a basic sensitivity of approximately 200mV (199.9 to be precise), and this is adjustable by means of a trimpot.

In the case of the pH meter we used a ready-made DPM05 module but, in the sample kit supplied to us, this module had to be assembled. We have been advised by Jaycar Pty Ltd that, in all probability, this situation will continue. For this reason, our instructions and diagrams are based on the assumption that the reader will have to assemble the DPM05 module himself.

The conditioning module contains the multipliers, shunts, reference resistors (for the resistance ranges), the rectifier for the AC ranges, and the switches to select these as required. The two modules are connected together with a short length of rainbow cable.

Our reaction to the kit was somewhat mixed. With one exception, the electrical design is fairly conventional for an instrument of this kind and follows good design practice. The exception concerns



DIGITAL MULTIMETER

7/MI-

This multimeter circuit is built around a DPM05 module which is essentially a high input impedance voltmeter with a full-scale reading of 199.9mV (see circuit p90). The heart of this module is the Intersil 7126 dual slope integration analog to digital converter chip. This chip also drives the liquid crystal display directly and yet draws only 50μA. IC3 is a high stability voltage reference and a divider is connected across this so VR1 can be adjusted to provide a Vref of 100mV.

The low battery indicator circuit uses voltage divider resistors associated with the emitter of Q1 to sense a low voltage condition. If this occurs, Q1 turns off and IC4a acts as an inverter to drive the "low bat" input.

In the complete multimeter circuit (above), S3 selects DC or AC functions and connects the battery to the appropriate circuit sections. Switch sections S1a and S1b feed the input to the voltage, current, resistance or diode check stages.

For DC voltage measurements, S2a selects the appropriate attenuator setting. The input impedance is 10MΩ.

For current measurements, S2b selects one of four shunt resistors. The value of the .05Ω shunt is chosen to allow for switch resistance. A fuse protects against excessive input currents while diodes D1 and D2 protect the circuit against high input voltages.

For AC voltage or current measurements, the input from S3a is fed via a .01μF capacitor to remove any DC component and thence to IC1 which is a TL061 Fet-input op amp connected as a precision rectifier. The gain of the op amp is set to indicate RMS values when measuring sine waveforms.

For resistance measurements, the 100mV reference from the DPM05 module is applied via S1c and S1d, to one of four 1% resistors selected by S2d. The resulting reference current is then passed through the unknown resistor connected to the meter terminals and the voltage across it is the resistance reading. The 1kΩ thermistor protects against any external voltages which may be present when "in-circuit" resistance measurements are attempted.

If an "in-circuit" voltage is present, D7 will turn on at about 6.8V to shunt the applied voltage. The resulting current through the thermistor causes its resistance to increase markedly and thus limit the current to a safe value.

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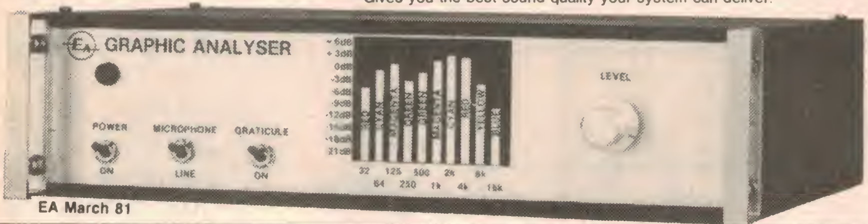

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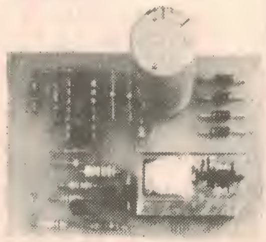

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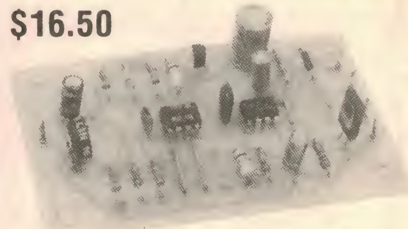

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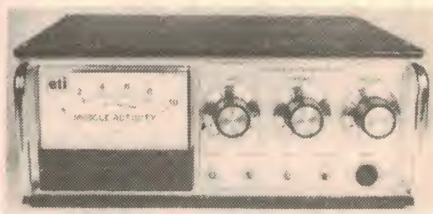

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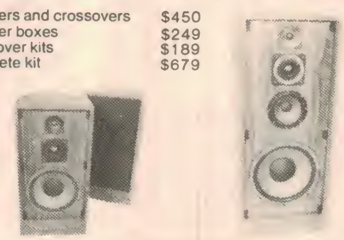

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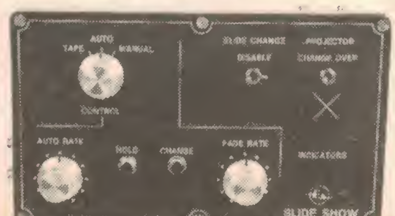

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the current ranges or, more exactly, the method of switching.

Switch contact resistance can be a serious problem in shunt systems and common practice is to use a double-pole switch; one pole as a "voltage" contact and the other as a "current" contact. This arrangement virtually eliminates the problem.

There is no such provision in this circuit. The shunts are selected by a simple, single-pole switch, and any contact resistances must be added to the shunt. This is not so bad for the two lower ranges (2mA and 20mA) where the shunt values are 100Ω and 10Ω respectively and reasonably high, relative to likely contact resistance. For the 200mA range the shunt is only 1Ω which brings it well into the danger zone.

The real cruncher

But the real cruncher is the fourth range, at 2000mA or 2A. The shunt for this, by calculation, would be 0.1Ω but is actually 0.05Ω, the explanation being that this value ". . . is chosen to allow for the effect of switch resistance." Thus half the shunt value is in the resistor and the other half as a rather nebulous value of switch resistance — a dicy arrangement to say the least. (Significantly, the tolerance on this range is quoted as 5%, but was a lot worse on our sample.)

Fortunately, the current ranges are probably the least used in practice, and the 2000mA range would be the least used of them all. The main thing is to be aware of the inherent limitation.

On a brighter note, the components appeared to be of very good quality and there was nothing missing. (There was one resistor left over, in fact, but it was genuinely surplus.) The printed boards, in particular, are of excellent quality. Both are double-sided boards and, in the case of the DPM05, plated through holes are used to transfer tracks from one side of the board to the other.

In the case of the DP200 board the through-board links are made by means of (6) small prefabricated pins, or by means of component pigtails where possible.

A word of warning here. The through-board links can be confusing in several ways. Some plated through holes serve no other purpose so that, when the board is finished, there are several unfilled holes which might confuse the constructor. Alternatively, where these holes lie adjacent to legitimate connections, there is the possibiltiy of confusion.

In the case of the DP200 board, where pigtails are used to provide through-board links, it is essential that these pigtails be soldered on both sides of the board. In spite of taking every care, we missed three.

Construction

We elected to assemble the DPM05 display board first. Although the wiring is quite complex, there are fewer components involved and the finished module can be tested by making a few connections to it, as shown in the accompanying test circuit diagram. It can also be calibrated at this stage, assuming that a suitable reference (100mV) is available.

The accompanying photograph shows this module partially constructed, to the point where the LCD module is about to be fitted. This sits above the 7126 and most of the minor components, and it is essential that these be mounted as close to the board as possible. In regard to the 7126, the only likely obstruction is the pair of 1MΩ resistors in the top right corner of the board. They need to be kept well to the right to clear the 7126.

Similarly, four polyester capacitors below the 7126 need to be mounted flat on the board. After inserting the pigtails in the appropriate holes, push the capacitor flat before soldering the pigtails. The .047μF on the left is pushed to the left, and the other three to the right.

In regard to mounting these capacitors note that there are a couple of plated-through holes near the .01μF which are not to be used. Similarly, there is a hole near (under) the 220kΩ resistor to the left of the 50kΩ trimpot.

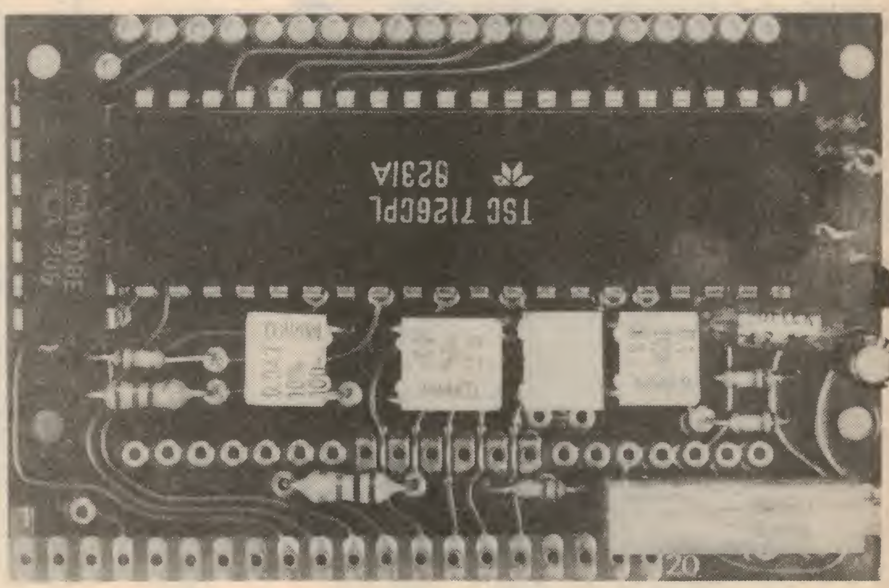
Several components need to be correctly orientated. These include the 7126 which has the notch to the right; the 4070, notch to the top; and the BC237 transistor, the 9491 IC, and the 10μF capacitor. Most electrolytic capacitors are supplied with the positive lead as the longer and/or the negative lead marked on the body.

Orientation of the LCD module is equally important and it is provided with a small detent in the mask at one end, together with a short bar alongside it. This mounts to the left. Note also that these displays are normally supplied with a sheet of protective plastic over the face, which can be removed prior to finally mounting the module in its case.

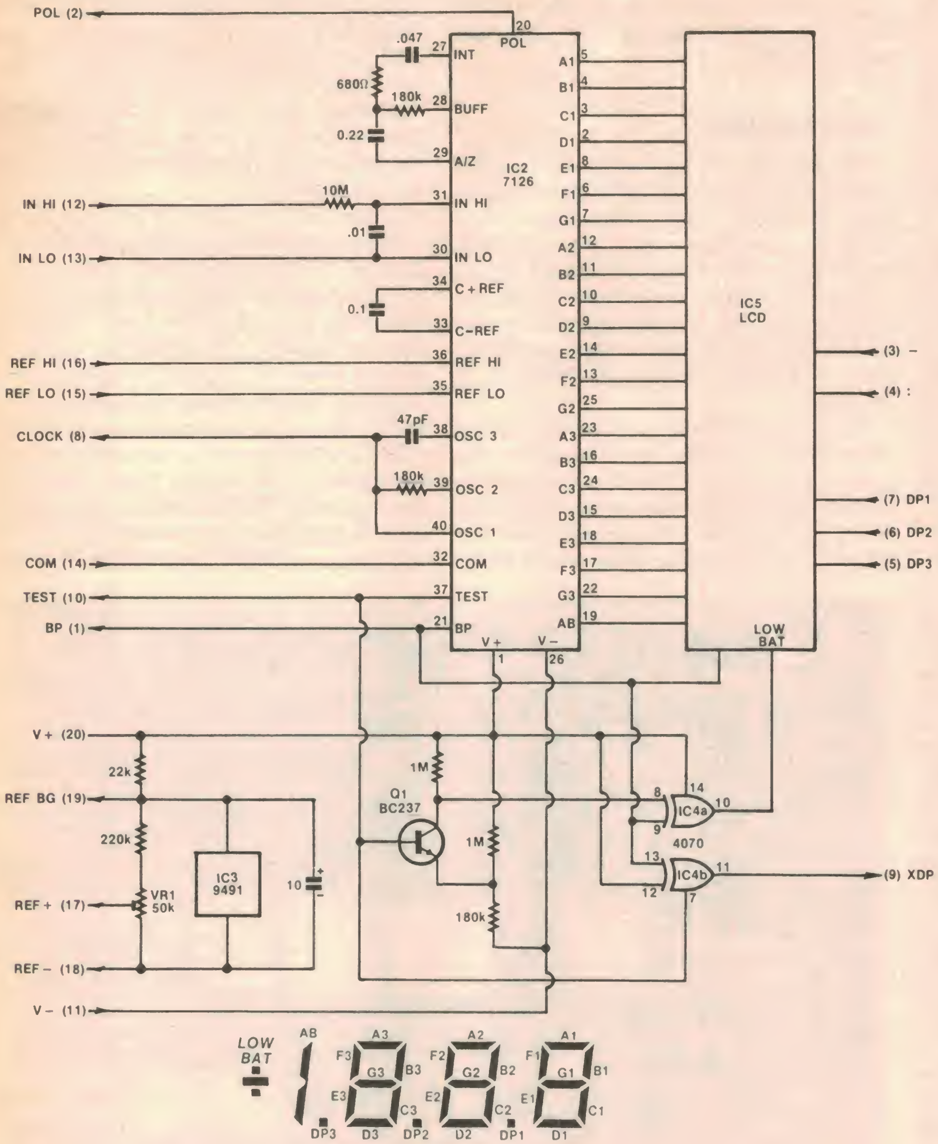
The position and orientation of all components should be clear from the parts overlay diagram, but we suggest that all the minor components be fitted, and their positions and values double checked, before soldering them. If possible, use an ohmmeter to check the resistor values. Once the LCD module is fitted, it will be a major operation to replace many of the other components, so it is important to get everything right the first time.

Of the 20 connections along the bottom of the board, only 16 are used in this application. Terminals 2 and 3 are connected together and the remaining 14 are connected to the DP2010 module via the short length of 14-conductor rainbow cable supplied.

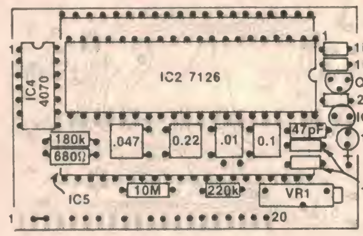
When the module is completed it may be tested, using the test circuit already mentioned. The battery clip is connected temporarily between pins 11 (neg.) and 20 (pos.), pins 18, 15, 14, and 13 connected together, and pins 17 and



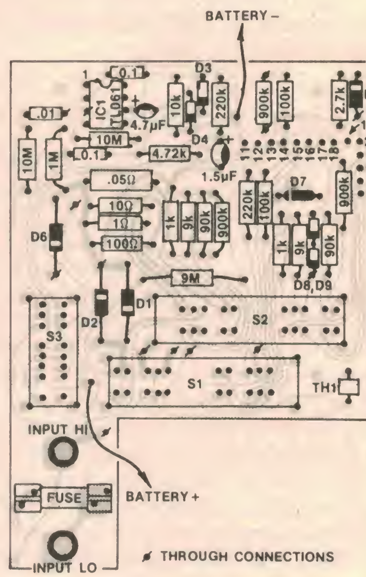
This larger than life size photo shows the partially built DPM05 module just before the liquid crystal display is mounted.



Left: the DPM05 module consists of an A-D converter (IC2), voltage reference (IC3) and exclusive-OR gates (IC4).



Parts overlay for the DPM05 module. IC2 is mounted beneath the LCD.



Parts overlay for the DP2010 board. Note the feed through connections – six by means of pins and eight using component pigtails.

16 bridged. Pins 2 and 3 should be already bridged. With the two input terminals (12 and 14) shorted, the display should read "000".

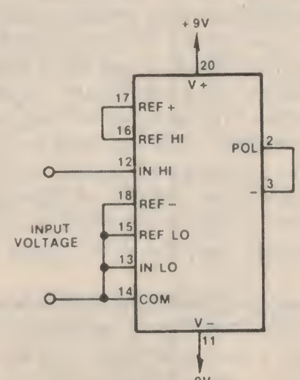
If possible, connect a 100mV reference to the input terminals, and adjust the trimpot until the display reads "1000". We used the DC Voltage Reference described in June 1976 but, even if a standard of this kind is not available, it is a good idea to arrange for approximately this voltage to be applied, if only to establish that the unit can be adjusted around the required sensitivity.

In the event that the DPM05 module is supplied ready assembled, it is still worthwhile making this test to confirm that all is well. However, ready assembled modules are normally also calibrated, in which case the trimpot should not be tampered with.

Assuming that all appears to be well, the display module can be put aside for the moment. At least, in the event that the final assembly does not work, this section should be above suspicion.

Assembly of the DP2010 board is more complex in the sense that there are more components, but they are not quite so cramped. The first task is to fit the six through-board pins supplied and solder them on both sides of the board. The positions are marked on the overlay diagram; four between the two large switches, one at lower left near the positive input terminal, and one at upper left near the 2000mA shunt. (Incidentally the makers use the terms "HI" and "LO" for the input terminals, meaning positive and negative respectively.)

The larger components can now be fitted; the three switches, which will only fit one way, the fuse clips, and the input terminals. In regard to these latter, make sure that they are perpendicular to the board. It is best to support the board upside down, while soldering on the back of the board. If crooked they will not line up with the panel holes. Similarly, the switches should sit square, to line up



Use this test circuit to check the DPM05 for correct operation.

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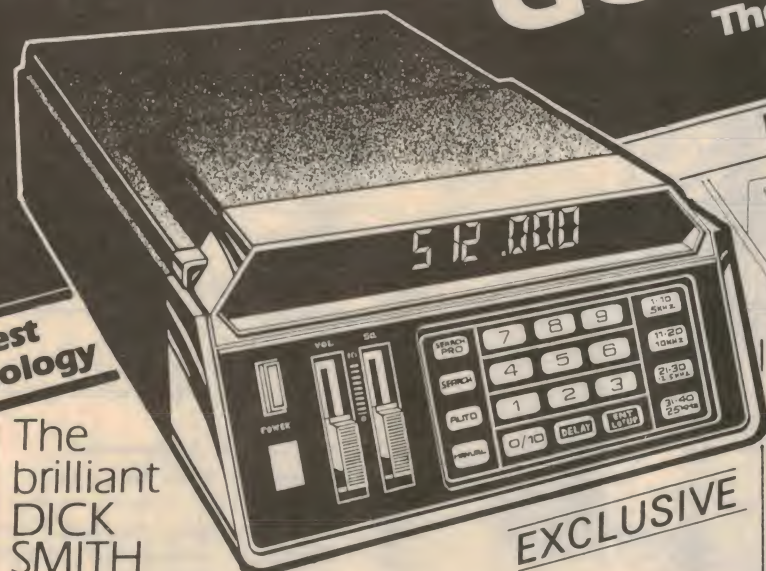

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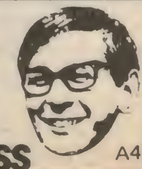

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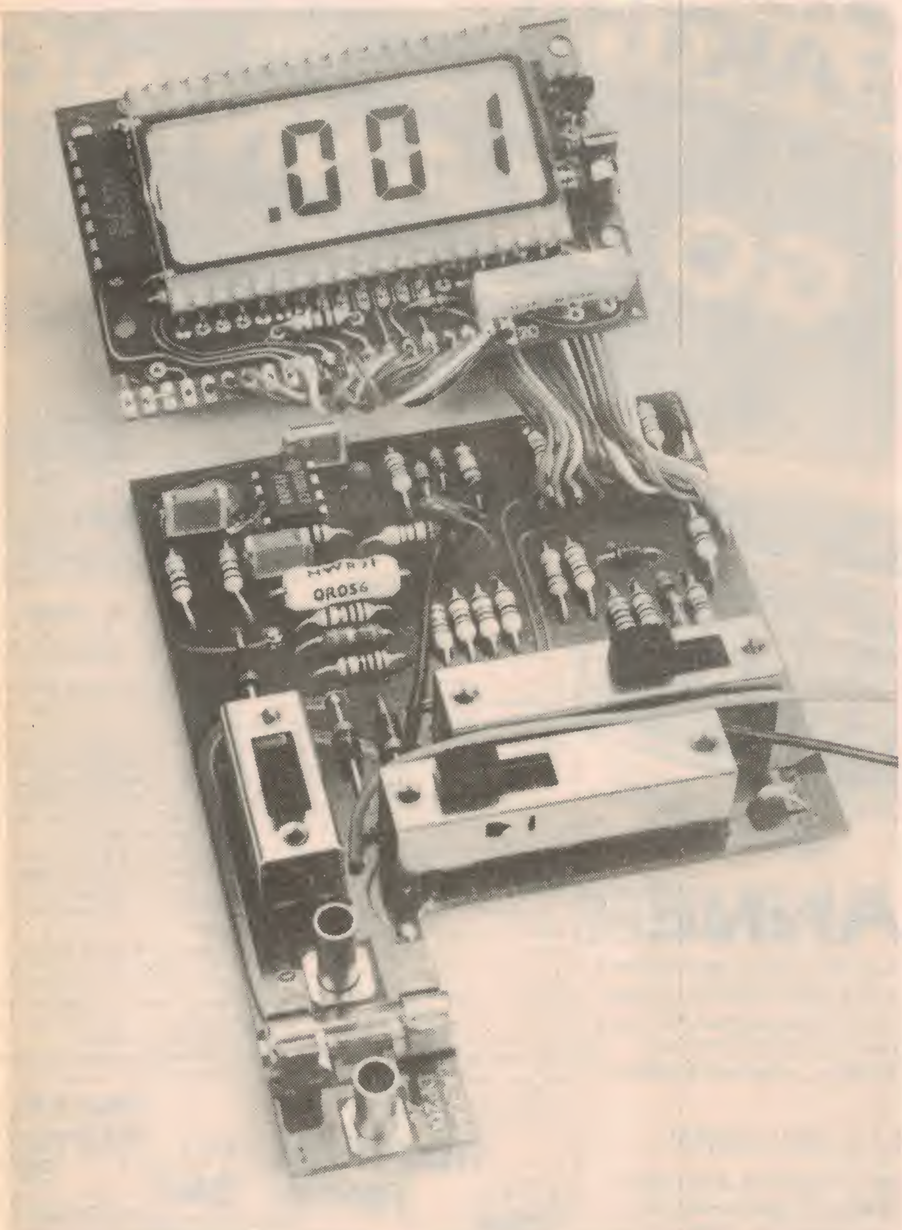
A405M/CT



This view shows the two PCB assemblies with all wiring complete. Unit fits neatly in a small plastic case that comes with the kit.

with the panel slots.

Probably the most exacting job is positively identifying the resistors before fitting them. There are a number of factors which may make this difficult for the beginner, and we most strongly recommend that you beg, borrow, or steal an ohmmeter (or DVM) for the job.

Some of the resistors are colour coded with the conventional three bands, plus a gold (5%) tolerance band, but the close tolerance ones use a four band code, plus a brown (1%) tolerance band. The tolerance band should be spaced away from the value bands, but this does not always happen, making it difficult to know in which direction to read the bands, particularly when there is a brown band at both ends. (In some cases the tolerance band is broader than the value bands.)

The four band colour code uses the same values as the three band system but, quite logically, the multiplier band will always be one less than that used for the same value resistor coded with only three colours. Try working out the colour code if you wish, but back it up with measurement.

Identifying some of the capacitors many also present a problem. The smaller values are listed in the accompanying literature in the unfamiliar and rather awkward nF (nanofarad) scale. This would not be so bad except that most of the actual components are marked in the more familiar μF scale. Our diagrams show the capacitor values in μF but, should it be necessary to convert, divide nF by 1000 to give μF.

There are several diodes, including a pair connected in series, and they must all be correctly polarised. The same applies to two electrolytic capacitors and one IC. These polarities are shown on the overlay diagram. There may be some confusion regarding the 6.8V zener mounting, since it leaves two unused holes. We understand the original design used a transistor in this position, but has since been modified. The zener sits directly above one of the holes.

Earlier, we mentioned that component pigtails are used as through-board links, and that these must be soldered on both sides. Once alerted, they should not be hard to find but, as a guide, there are eight. Failure to solder these connections can result in either complete failure of some of all of the functions or, worse still, intermittent operation if the pigtail happens to make partial contact with the board pattern.

Once again we recommend that all components be fitted and values and positions checked before soldering although, in this case, changing a component does not present the same problem as with the DPM05 board.

Finally, the rainbow cable can be fitted to the "L" shaped group of holes in the top right corner. If you are not used to handling rainbow cable be aware that the conductors are very fine, and easily damaged when stripping the insulation. Many workers prefer to melt the insulation with the tip of the soldering iron, at least as a first step.

Separate the conductors for about 25mm at the DP2010 end, and a little more at the DPM05 end. The terminations are not in the same order on each board, and it will be necessary to cross over one group of four conductors at the DPM05 end.

At this point is should be possible to connect the battery, switch on, and get some kind of reading. Set to DC volts the display should read "000" with the decimal point moving as each range is selected. In some cases it may read "001" or dither between "001" and "000" or even cycle regularly between "−001', "000", and "001". This is quite normal.

The mA ranges should give a similar display, as should the voltage and current AC ranges, although these take a little longer to settle to the zero reading. Switching to the kΩ range and the diode range will give the "over-range" indication; the left-hand "1." without any following zeros.

Assuming that all these ranges work as

indicated, they can be checked against known values. If the display module was calibrated at the testing stage against a 100mV standard, all the ranges should be within the specified tolerances, as dictated by the shunts and multipliers. In this case it should only be necessary to check against another instrument to insure that there are no gross errors due to a faulty or misplaced component.

If it was not possible to calibrate at the 100mV level, the next best thing is to calibrate it against the best standard available. A 10 or 12V source, monitored by the best meter available, is probably the most convenient arrangement, the trimpot being adjusted to give a matching reading. This is not quite as good an approach as the 100mV calibration, but may have to suffice initially.

The diode test ciruit is a very handy feature. A good diode will read "1." (over range) in one direction and ".6" (approx.) for a silicon diode, or ".2" (approx.) for a germanium diode, in the other direction. It will read ".000" in both directions if short circuit, or "1." in both directions if open circuit. Its reading is limited to 2V.

Current consumption from the 9V battery is approximately 200μA, which should give a long battery life. When the battery does drop below an acceptable level a "LO BAT" indication will appear in the top left corner of the display.

Finally, the two modules can be mounted in the case. The case proper consists of two sections which press together and are held by two long self-tapping screws (supplied). There is also a small bezel which mounts on the outside of the case and supports the display module on the inside, the latter being secured with four small self-tapping screws (supplied).

The DP2010 board simply sits on the bottom of the case, retained by three locating studs which fit three holes in the board. The rainbow cable will need to be folded appropriately to allow everything to fit, and there is not much room to spare.

The battery is also a rather tight fit in the battery compartment, and it may take a little juggling to get the battery cover into place. If it will not slide into place, engage the retaining tongue and then press the cover into place.

Our sample unit, in its final form, performed more or less within the specifications given in the accompanying literature. All the voltage and resistance ranges appeared well within tolerance, as did the two lower current ranges. As already stated, the two upper current ranges were less satisfactory.

The 200mA range is quoted as having an accuracy of ±2% whereas, in our model, the error was closer to 5%. In the case of the 2000mA range the quoted accuracy is 5% but, in fact, the error was closer to 15%.

But, these reservations aside, the end product is a very handy little meter. It should appeal particularly to the beginner on the basis that its construction will provide a very useful practical exercise and some background theory, plus the fact that the finished product will be a very useful addition to his work bench.

PARTS LIST

DP2010 module

1 plastic case
1 bezel
2 20mm fuse clips
1 1A fuse
1 battery snap connector (216)
2 4mm terminals
1 printed board, DP200
6 through board pins
15cm 14 conductor ribbon cable

SWITCHES
1 4-pole, 3-position
2 4-pole, 4-position

SEMICONDUCTORS
1 TL061 operational amplifier
4 1N4004 diodes
4 1N4148 diodes
1 6.8V zener

CAPACITORS
1 4.7μF/16VW electrolytic
1 1.5μF/16VW electrolytic
2 0.1μF/100V polyester
1 .01μF/100V polyester

RESISTORS (½W, 5%)
2×10MΩ, 1×1MΩ, 2×220kΩ, 1×100kΩ, 1×2.7kΩ. 1×1kΩ thermistor.

RESISTORS (¼W, 1%)
1×9MΩ, 3×900kΩ, 1×100kΩ, 2×90kΩ, 1×10kΩ, 2×9kΩ, 1×4.72kΩ, 2×1kΩ, 1×100Ω, 1×10Ω, 1×1Ω, 1×.05Ω (2W)

DPM05 module

1 printed board, DPM05/3B

SEMICONDUCTORS
1 7126 A/D converter
1 4070 exclusive –OR gate
1 9491 voltage reference
1 BC237 transistor
1 3½ digit LCD

CAPACITORS
1 10μF electrolytic
1 0.22μF polyester
1 0.1μF polyester
1 .047μF polyester
1 .01μF polyester
1 47pF polystyrene

RESISTORS (½W, 5%)
1×10MΩ, 2×1MΩ, 1×220kΩ, 3×180kΩ, 1×22kΩ, 1×680Ω, 1×50kΩ trimpot

GREAT NEW PROD

CLEF ELECTRONIC MUSIC MICROSYNTH

COMPACT MUSIC SYNTHESIZER

Equally suited to home, studio or stage use, the Microsynth has resulted from an extensive re think of what is required from a synthesiser. Its compact and economic design achieves high performance at low cost out sacrificing versatility or musical stability

A highly efficient switched routing system for signals and or control voltages is capable of rapid operation for live work, yet unlike other small synthesisers does not restrict the possibilities for complex sound creation. Despite its small size, the Microsynth can produce startlingly rich sounds owing to the number of waveforms available, together with the sub-octave voices. It is capable of advanced effects such as Ring Modulation as well as rhythmic "staircase" or random patterns.

Operates in two modes depending on the configuration of the second oscillator (VCO2), which can either run at audio frequencies or as a voltage controlled low frequency oscillator (LFO). In audio mode, VCO2 will track VCO1 perfectly over its entire range. A Thumbwheel allows manual control of oscillator pitch or filter cut off frequency, depth of LFO modulation, etc., and internal power amplification will drive headphones or a monitor loudspeaker

SPECIFICATIONS (BRIEF)

* Keyboard – 2½ octaves (30 notes) may be stepped through 5 octave range from 16' to 1' using the "Range" switch * VCO1 – 10Hz to 10kHz, triangle output to VCA, ramp and square outputs to VCF * VCO2/LFO – VCO mode 10Hz to 10kHz. LFO mode 0.1Hz to 30Hz * Sub octaves – 2 divide-by 2 * Noise – white noise source with level control. * Envelope – attack and release times variable 0 to 10 seconds * Retrigger – causes the envelope shaper to retrigger itself with a repeat time equal to the sum of the attack and release times. "Sustain" operates in 3 modes, manual, auto and hold. * VCF – state variable filter with manual control of roll-off frequency. * VCA – controls output volume of synthesiser * Sample and Hold – analogue memory samples instantaneous output voltage from VCO2/LFO each time envelope ends. * Sweep * Thumbwheel – Manual level control * Power amp – output 2 watts into 8 ohms plus headphone socket * Sequencer socket * Size: 19½" x 14" x 5½". Weight: 10lb. Power: 240V AC 5W.

$399 kit

Cat. KJ6002

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Program Intros, Chorus Repeats, Codas, Key changes and modulations on single or multi tune sequences. Use simple Playback procedures for live performance, including optional foot operated controls

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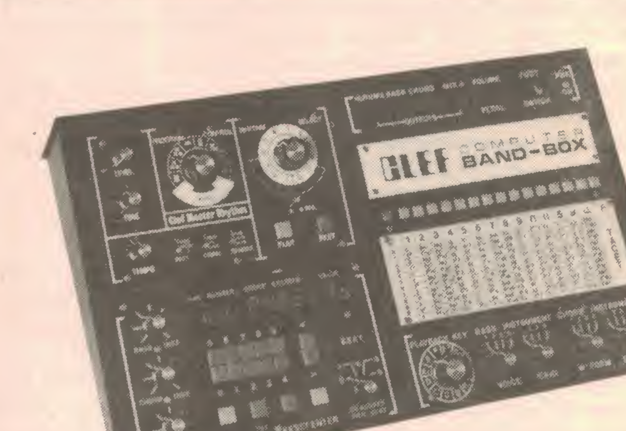
SPECIFICATIONS (BRIEF)

* Music simulation capacity – three backing instrumentalists. Over 3,000 programmable stored chord changes. 132 different chords plus additional inversions. * Chord instrumentalist – four note chords, four waveform options, four envelope options sixteen permutations for piano, organ etc, twenty four programmable rhythm patterns. * Bass instrumentalist – four voice /envelope combinations, eight rythmic figures * Drums – twenty four programmable patterns, eight tracks selecting eleven instrument sounds. Sticks, brushes & Latin American, Sequence operation up to 16 bar repetition. * Playback facilites – Keypad selection of score, display of selected score, variable tempo, switched selection of any key, in play changes to key, tempo and all instrument voices, rhythmic patterns and levels, bar down beat indicator, all beat indicator, unlimited chorus repeats, Coda key to cancel repeats, automatic stop, manual instant stop, automatic reset to beginning of selected score, measures/beat selectable to match 4 drumming styles. * Composition facilites * Composition instructions * Pre recorded scores * Musical compass – Tuning range one semitone, use alternative key for gross pitch change, Bass compass 16 notes, F1 to G2 44Hz to 104Hz, chord instruments 18 notes E3 to A4 165Hz to 440Hz, automatic chord inversion to fit compass * Percussion instruments – Bass drum, low & high tom toms, snare, drum, rim shot, cymbal, long & short brushes, high bongo, claves, and accent for dynamics. * Operator interfaces – numerous * External socket: numerous * Size 19" x 11" x 4½" overall. Weight 11lb. Power requirements 240V 6W

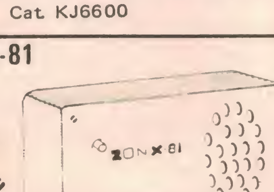


(MASTER RYTHM KIT EXTRA) **$699**

Cat. KJ6600

Cat. KJ6604

SINCLAIR ZX-81 COMPUTER SOUND GENERATOR



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Cat. KJ6620

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If your deck is more than 3 years old and has had a bit of work its quite possible that the record replay head is worn. This can lead to poor H.F performance. Or it may have never been any good in the first place Or you may want better performance than the head in your car cassette player can give.

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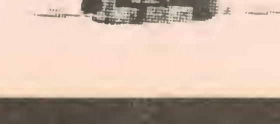
(All record/playback have mounting hole centres on 17mm pitch and 12.5mm from face of head)



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You may have wondered why Jaycar did not (until now) sell home computers. We had many reasons but our main one was that we were not entirely "happy" with any of the units currently on the market. The closest we came to what we thought was a pretty good computer was the Apple. We thought that it was, quite frankly expensive. However it was sold and serviced throughout Australia by a reputable sales network — so there was no need for Jaycar!

That's why we got so excited when we saw the "Micro Professor MkII". It is the closest thing that we have seen to be software compatible with the Apple. Yes, we know what you're thinking. It's NOT one of those cheap Taiwanese "Apple" copies which infringe Apples' copyright. The Micro Professor MkII is a completely new and unique design in its own right. It just so happens that most of the widely distributed Apple software will run on this machine. O.K. But why so excited? LOOK AT THE PRICE! Check out the STANDARD FEATURES of this unit. Sit down. Think about it and COMPARE what you get with the Micro Professor MkII as STANDARD that are options on other machines!!

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SPECIFICATIONS

CPU		R6502
ROM		16K Bytes Paddle Optional
RAM		64K Bytes
BASIC	Interpreter	More than 90 instructions stronger than those for Apple ii
Video	Type	Memory mapped into system RAM
Display	Mode	Text, low-resolution graphics, high resolution graphics (3 modes are mixed)
	Screen Format	960 characters (24 lines, 40 columns)
	Character Set	Upper case ASCII, 64 characters
	Character Type	5 x 7 dot matrix
	Graphics Capacity	1920 blocks (low resolution) in 40 x 48 array, 53760 dots (high resolution) in 280 x 192 array
	Number of Colors	6 colors
Keyboard		49 alphanumeric and function keys
Cassette	Interface	Use various cassette tapes and cartridges as data storage units
Software	Cartridge Interface	
Printer	Interface	Connects to printers with Centronics I/F
Display	Interface	Connects to color TV or video display
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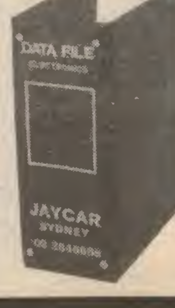

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The Serviceman

Where did all the microvolts go?

My regular readers may recall that I sometimes relate stories passed on to me by a colleague on the NSW south coast; an area where antenna problems abound and it often takes a good deal of ingenuity to provide a satisfactory signal. For the benefit of others who may face similar problems, here is a story about how one such exercise went wrong, and the reason for it.

For those not familiar with the area in which my colleague works I should explain that there are two basic reasons for reception problems there. One is that the country is very undulating and, even though the area has two TV transmitters of its own – a commercial station on channel 4 and an ABC station on 5A – there are still many places where, due to distance and/or intervening ridges, reception can be very patchy.

A further complication – though not a factor in this story – is that many residents are not content with the local channels; they want the Sydney stations as well. And because some are lucky enough to live in a location which favours these signals, others feel that they should also be able to get them.

So much for the background. Here is the story in detail, more or less in my colleague's own words.

To fully understand this story it is necessary to have some idea of the geography of the site involved. It is some 100km south of the transmitting site, and situated on the northern side of a slight rise, running roughly east and west. The ground slopes downwards to a small gully, then rises to form a second ridge, also running east and west, about a kilometre to the north. Unfortunately, this second ridge is about 25m higher than the house in question, making it a very effective shield for TV signals.

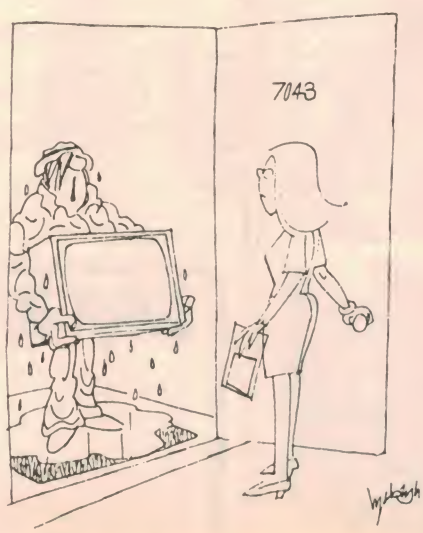
A NEW ANTENNA

The people concerned have been customers for many years, but their TV equipment to date has been rather primitive; an old monochrome set working from, of all things, a pair of rabbit ears. The results, needless to say, were pretty pathetic. The channel 4 signals were "acceptable" (depending on what one is prepared to accept) but the ABC signals on channel 5A, which tend to be the weaker of the two in this area, were virtually useless.

Things came to a head when the old monochrome set finally blew its fuses for the last time and the family decided that it was about time they had a colour set. They sought my advice as regards the various brands available, and I did what I could to help, then directed them to one of the local dealers for a demonstration and to make their final selection.

And, naturally, part of my advice concerned the antenna. I pointed out that there wasn't much point in spending $700 or $800 on a new set and then fail to do justice to it by not feeding it with a decent signal. They saw the sense of this, and promptly commissioned me to fit a suitable antenna.

Anticipating the likely problems I took along the field strength meter and made a brief survey of likely antenna spots on the roof. I finally settled on a spot where, using a four element combined 4 and 5A antenna, supported by a "hockey stick" mast mounted on the barge board near the ridge of the roof, I was getting about 250μV on channel 4 and about 200μV on channel 5A. Neither figure was anything special but, with the set they had chosen, I felt they should lift the pictures out of the snow.



"I see you've installed a swimming pool."

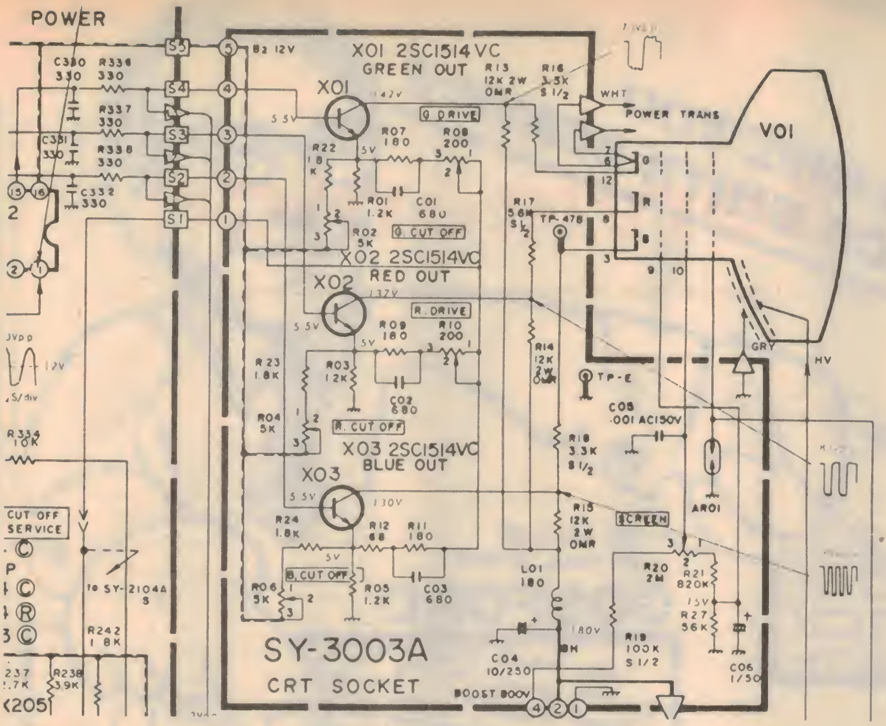
And that's how it worked out. The new set was duly installed and gave good pictures on both channels; certainly far better than anything that family had ever seen on their old monochrome set. So everyone was happy and I reckoned that, with the new set under warranty, it would be a long time before I would have a service call to that installation.

Alas: the best laid plans . . . etc. A mere six weeks went by and the lady of the house was on the phone with the sad news that they could no longer receive the ABC channel 5A. The news didn't worry me particularly, because I reckoned I knew the answer. There were small children in the house and, from previous experience, I figured that someone had been fiddling with the fine tuning control.

WHERE'S THE SIGNAL?

Not wanting to make a long trip out into the country for such a routine adjustment, I immediately raised this possibility with the lady. But she assured me that this point had already been considered and checked. As far as she was concerned the fine tuning was correct. I was still far from convinced, but there was little I could do about it. If they were prepared to pay for a call to set the fine tuning – well, that was up to them.

So convinced was I that it was simply a fine tuning problem that I didn't even bother to take the tool kit into the house, fully expecting to be on my way out in a couple of minutes. But I was in for a shock. Switching the set on produced a good picture from channel 4, just as the lady had said, but channel 5A was hopeless. Weak, noisy sound, and a few



Output stage of the JVC 7765AU. A 5.6kΩ resistor across R01 restored the green.

faint lines of picture behind a blanket of multi-coloured snow.

I reached for the fine tuning control and gave it a twist, only to lose what little sound and picture there was. The lady was right; the fine tuning control had been just about spot on. So what was going on? A fault in the set? If it was it would have to be a tuner fault, and this seemed unlikely with a new set. In any case, I didn't want to appear to be passing the buck, until I was really sure.

An antenna fault? This seemed more likely and I fetched the field strength meter from the van to check exactly what it was delivering. There was no surprise with channel 4: it was delivering about 250μV, just as when I had installed the system. But channel 5A was another matter; there wasn't even enough signal to move the needle.

So out came the ladder and up on the roof I went, fully excpecting to find some serious mechanical problem in the antenna. But I could find nothing wrong; as far as I could see everything was exactly as I had left it.

I fetched my survey antenna, hooked it up to the field strength meter, and went back onto the roof. Even allowing for the presence of the house antenna, I hoped I would be able to get some idea of the signal strength around it; enough to indicate whether I had an antenna fault, or whether the channel 5A signals had simply vanished.

Well, to cut a long story short, I was eventually forced to accept the latter proposition; Channel 5A signals just didn't exist at that point any more. And, having accepted it, there was only one thing I could do; start all over again and hope that I could find a new spot which would deliver acceptable signals.

And that was the next surprise. I found such a spot only about one metre to the west of the previous position and about 60cm lower. In fact, it was a better position than the previous one: I now had about 350μV on channel 4 and between 275μV and 300μV for channel 5A.

From then on it was fairly routine. I fixed the antenna permanently in the new position, and then checked the set's performance. As I expected, it was really good. So, as far as the customer was concerned the problem was solved and that was more or less the end of the matter.

But I'm afraid I couldn't write it off as simply as that. Why had the signal vanished? What had changed? And, most important, would it change again? Naturally, I didn't relish the idea of having to visit the site every few months to find a new antenna position, simply because someone was parking their car in a different spot or something equally silly.

In fact, this is not the first time that I have encountered problems of this kind but, in the past, the reason for the change has usually been immediately obvious, or easily found. New buildings in the immediate vicinity can often play havoc with weak TV signals, and this is the first thing I thought of. Unfortunately, there was no such building activity anywhere nearby that I could see.

In an effort to solve the problem I questioned the family as closely as was diplomatic. Were they aware of any changes; any building alterations, or anything similar which might provide a

clue? They shook their heads collectively. So I tried another tack. Exactly when did the signals vanish? Suddenly the lady's eyes brightened. Yes, she could help there. She recalled that they had watched an ABC program the previous Wednesday night, she was unsure about Thursday, but realised that they had no signal on the Friday. So the signal had vanished sometime on the Thursday or the Friday.

Which was all very interesting but, on its own, not very useful. It seemed destined to remain an unsolved mystery. Then, as I walked out to the van to drive away, I looked across the gully to a small group of houses about half a kilometre away on the southern side of the previously mentioned ride, and about 20m below the top of the ridge.

Although the area was partly obscured by trees I fancied I could see a house under construction. It was a round about route to get to the other side of the gully, but I eventually found myself in the appropriate street and confirmed my suspicion. There were only a few houses in the area anyway, and the new one was obvious. Clearly planned as a brick veneer it was, at this stage, little more than the timber frame and a tiled roof.

There were several workmen present on the site so I strolled over and, on the pretext of being interested in the house design, struck up a conversation with one of them and, at the same time, managed to get a look under the tiled roof. As I expected, the roof was lined with bitumen impregnated insulation, coated with aluminium foil. Could this possibly be the answer, half a kilometre away, and well down the hillside?

As casually as possible I put the question, "When did you put the tiles on?" There was a brief consultation, then someone announced, "Last week."

"Do you remember which day? Which day you put the foil on, and which day you put the tiles on?"

More consultation; then, "It was Thursday. We put the foil on on Thursday and the tiles on on Friday."

I thanked them, made a little more polite conversation, then took my leave. In retrospect I realise it must have seemed a funny conversation. Why on earth would a TV serviceman want to know exactly which day the foil and tiles went on a strange house? I suppose they wrote me off as some kind of drongo.

But, as far as I was concerned, I had all the evidence I needed. Granted, it was circumstantial, and not enough to hang someone on, but it was enough to convince me. And I wonder whether the dimensions on some of the foil sheets might just happen to approximate some fraction of a wavelength at 5A's frequency?

Well, that's my friend's story and I think it demonstrates, if nothing else, just how vunerable are the reception conditions in fringe areas. And, while I hesitated to mention it to my friend, I can't help speculating on how many more houses are likely to be built on the other side of that particular gully. I understand there are plenty of vacant blocks!

NO GREEN SIGNAL

My next story comes from my own bench, and is on a completely different theme. The actual incident took place several months ago and I held off writing it up, initially, to make sure that the job didn't bounce and later because I had other stories which were more topical. Anyway, the end result has been a long testing period, the significance of which will become apparent later.

Another interesting aspect of the story was the customer's reaction to the original fault. To be perfectly honest, my opinion of the average viewer's sense of the artistic, colour balance, or visual fidelity — call it what you will — is pretty poor. For most of them a picture is perfectly satisfactory if (1) it moves, and (2) it is coloured.

It matters little what the colours are, or how they relate to colours in real life. Let the average viewer loose with contrast, brightness, and colour controls and he is likely to produce something that might well rival "Blue Poles" as a surrealistic masterpiece — apart from the price tag, that is.

Against such a background, based on years of experience, it came as a very pleasant surprise to encounter a customer who was both critical and accurate in their assessment of picture quality. The customer in question was a lady who had been a regular customer for many years. The set was a JVC model 7765AU, about five years old, and for which I had erected an antenna when she bought it.

Her description of the fault, when she rang me, was that the set had lost its green content. Such a positive statement was, in itself, quite a surprise. Most customers — if they realised that there was anything wrong with the picture at all — would probably not get beyond describing the picture as "... having gone all funny".

I asked a few discreet questions and was forced to the conclusion that the description was very probably quite accurate. And she went on to describe the sequence of events leading up to the failure. It appeared that she was watching the set when suddenly, in the middle of a commercial, there was "... a great rainbow of colours, which I thought was part of the commercial. But when the mass of colours subsided, the picture had lost its green content."

So I made an appointment and, in due course, fronted up to the offender in the lady's lounge room. Her description was completely accurate; there was no green in the picture at all. But having clarified that point, and taking into account how the failure had occurred, I wasn't quite sure what to look for.

If it had been a gradual loss of a colour, in a set of that age, I would have guessed that the picture tube was on the way out, with that particular gun being the first one to show its age. Even so, it is often possible to restore the performance, simply by grey-scaling the set, assuming that there is sufficient reserve performance left in the gun.

But the sudden onset of the fault, coupled with the total lack of green, seemed to suggest that the green gun had suffered a catastrophic failure; meaning a new tube. Except for one thing. The lady pointed out that, when the set was first switched on from cold, the first colour to appear on the screen was green. Then, as the tube warmed up, the green faded out completely. I checked this, just to make sure, but I wasn't really surprised when it proved to be exactly as the lady said.

TESTING THE TUBE

So was it a failure of the green output stage or associated drive circuitry? At that stage I decided to try grey-scaling the set, just to see what happened and, hopefully, pick up a clue in the process.

In this set luminance and chrominance signals are mixed in the red, green and blue output stages. The red, green and blue chrominance signals from the demodulator, IC302, are fed to the respective bases, while the luminance signal from the video amplifier, X207 etc, is fed in parallel to the three emitters via suitable isolating and gain control networks.

More specifically, the luminance level to the blue stage is fixed, and the levels to the red and green stages only are variable, via R10 and R08 respectively, each being a 200Ω pot. These are designated as "drive" controls. At the same time, there are three "cut-off" controls, again in the emitter circuits, R02, R04 and R06, each being a 5kΩ pot fed from the 12V DC rail.

There is also a "screen" control, a 2MΩ pot, R20, which varies the voltage on the picture tube G2, and serves as an overall sub-brightness control. The two "drive" controls are used to adjust the low lights, and the three "cut-off" controls to adjust the high lights.

All of which turned out to be of little

more than academic interest, because no amount of adjustment of the green drive control, or cut-off control, did anything to restore the green. So my next move was to make a voltage check around the drive stages, fully expecting to find that the green output stage collector had gone high and was cutting off the green gun.

But, again, no joy. All three collector voltages were as close as one could wish, ranging from 130V on the blue stage to 140 odd on the suspect green stage.

At this stage my suspicions swung back towards the tube since, superficially at least, it appeared that all the right signals and voltages were being fed to it, yet it would not respond. But I hesitated to make a firm decision without being absolutely sure, considering the expense involved. So I suggested to the lady that I take the set back to the workshop for a more detailed examination, just in case there was something I had overlooked.

With the set on the bench I went through the .adjustment and voltage checks again, with the same result. Then I decided to try another trick; interchanging the drives from the output stages.

Unfortunately, all these connections were soldered, but I went ahead with the idea, even if it did take a little longer. And the result only added to the confusion, because I was able to get a green image on the tube. Another trick is disconnect the cathode of a suspect gun from its drive source and connect it briefly to chassis, which should turn the gun hard on. Again I brought up the green, and quite brilliantly.

Thoroughly confused, and by no means convinced that I should replace the tube, I went over the circuit again, but could find nothing wrong.

WHAT NOW?

Which brought me pretty well to a full stop. The only other check I could think of was an emission test on the tube. Frankly, I don't have a great deal of confidence in such tests, but the main problem was that I did not have a suitable adaptor to match this tube to my tester.

My best assessment of the situation, taking all the symptoms and tests into account, was that there was nothing wrong with the circuitry up to the tube. That left the tube as the main suspect, yet I had proved that it could produce green if suitable voltages were applied.

So, was it possible to brute force the green gun into working, if only to prove the point or perhaps provide an additional clue? I took another look at the circuit and, particularly, the biasing system for the green output stage. Part of this system is a 1.2kΩ resistor from the emitter to chassis, forming part of the voltage divider network from the 12V rail via R02 (the 5kΩ pot) and R22, a 1.8kΩ resistor.

What would happen if we reduced the value of the 1.2kΩ slightly, increased the collector current, reduced the collector voltage, and turned the green gun on a little harder?

It wasn't hard to try. There was a 1.5kΩ resistor lying on the bench and, at a rough guesstimation, I calculated that, in parallel with the 1.2kΩ it would bring the total down to about 700Ω. I tacked it across the 1.2kΩ, switched the set on again, and waited for the tube to warm up and stabilise.

The result was quite dramatic. We now had green all right; far too much of it. Reassessing that situation I removed the 1.5kΩ and reached for something rather higher; a 5.6kΩ which I calculated would produce something between 900 and 1000Ω. And that really hit the spot. It brought the green adjustment well within the range of the drive pot, R08, and, on going through a rough grey scale adjustment, we finished up with this control at about its mid point and very close to where it had been before.

THE PROBLEM SOLVED

So we had, in fact, solved the problem, as distinct from curing the fault. But how legitimate was this approach? It was, not to put too fine a point on it, a form of butchery, something which I have always striven to avoid. On the other hand, it could do the set no harm, apart from driving the green gun a little harder. And if it was the green gun which was at fault – which I strongly suspect – then what did we have to lose? The tube would have to be replaced anyway, and if we extended its life by only 12 months it would surely be worth it.

So I decided to take a chance, particularly as this customer was able to understand what it was all about and unlikely to complain if the idea didn't work out. And, as I explained at the beginning, that was several months ago and the set hasn't missed a beat since. I've no doubt it will last 12 months, probably a lot longer.

And what was the nature of the fault in the first place? It's only guess work, of course, but my theory is that, when the tube turned on its kaleidoscopic display, it was the result of a lose fragment of metal or cathode material shorting some of the electrodes and being vaporised. Whether it was a metal fragment or cathode material the cathode was most probably involved, and lost some of its emitting surface as a result.

This, in turn, could have completely changed the operating conditions of that gun, such that it was virtually cut off at the normal grid/cathode voltage. But, by reducing this voltage, it could be made to work again.

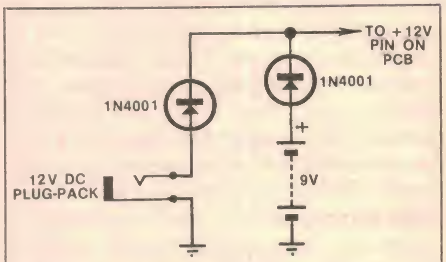
Well, if anybody has any better ideas, I'd be happy to hear them.

Simple circuit prevents loss of stored data

Battery back-up for the Car Computer

Having painstakingly built your EA Car Computer and installed it in your beloved Kingswood, imagine the heartache of having the computer, or worse (?) the Kingswood, stolen. It's a sad fact that any desirable accessory fitted to your car impresses not only passengers but also car thieves. With this easy modification you can remove the computer from your car to prevent theft but not lose any of the stored data.

by COLIN DAWSON



Two 1N4001 diodes and a 9V battery make up this simple circuit.

Parts List

2 1N4001 diodes
1 4-way tag strip
1 socket (to suit plug pack plug)
1 9V battery, Eveready 216, etc
1 battery snap connector to suit
Hook-up wire, scrap aluminium

To remove the temptation from thieves, it is feasible to disconnect the car computer and hide it from view in the boot or elsewhere. The computer's only interface with the car wiring is through a 12 pin Utilux connector and with thoughtful mechanical installation it can be removed in a matter of seconds. Unfortunately, every time the computer is disconnected it loses any stored data. This includes the fuel flow sensor calibration figure, as well as any trip data. This information must be re-entered each time the computer is connected and the tedium of doing this on a daily basis would tend to discourage most motorists.

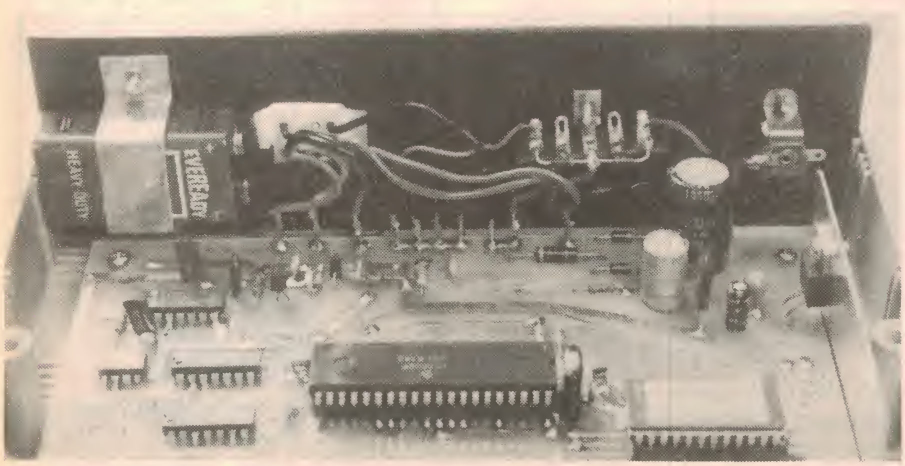
Presented here is a simple and inexpensive method of providing standby power for your car computer. A 9V 216 type transistor battery supplies power to the "12V" connection of the computer via a diode. This takes advantage of the "Vcc Standby" facility of the 6802 microprocessor used in the computer, whereby 128 bytes of memory can be retained with a current drain of only 12mA. The calibration figure and trip data are contained in this 128 bytes of memory.

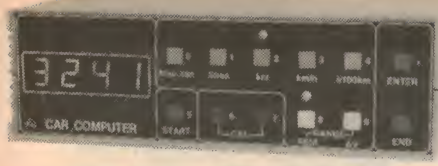
A socket on the back panel of the car computer will allow the standby power to be provided from an external source. This might be a suitable outlet installed in the boot of the car or a plug pack transformer for indoor storage. Although the battery can supply power for up to eight hours continuously, it is primarily intended to allow the computer to be moved from one power source to another without losing its vital data.

Because the standby power is connected to the "12V" terminal of the computer via a diode, it is not necessary to provide any switching in the circuit. The diode is normally reverse biased, effectively disconnecting the standby battery. To forward bias the diode, the "12V" terminal must fall to within 0.6V of the standby voltage. This will happen either when the car battery is very flat or when the computer is disconnected. In the case of the flat battery, the standby circuit will be of no assistance, but it effectively prevents the "12V" terminal from losing power in the event of disconnection.

The power socket on the back panel is also connected to the "12V" terminal via a diode. The purpose of this diode is to protect the battery from a plug having reverse polarity. The computer itself is immune to reversal of input polarity, having a protection diode. The battery diode, however, would be forward biased, subjecting the battery to a reverse polarity charge. This could easily damage the battery, causing it to leak.

The standby power – as we have presented it in this article – is an automatic function. As soon as power is removed from the computer, it takes


This view shows how the battery back-up circuitry is mounted on the rear panel of the Car Computer. The two diodes are mounted on tag strip.



The EA Car Computer was described in the July, August and September 1982 issues (File 3/AU/30,31,32).

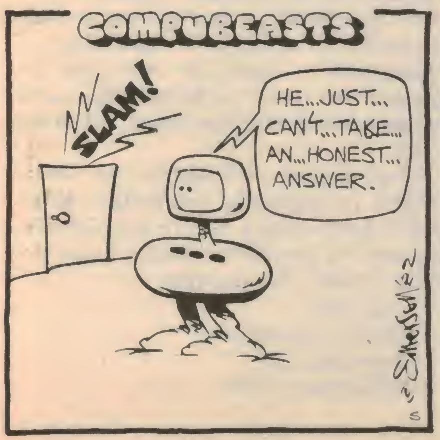
over and continues to provide power until it is exhausted. A possible disadvantage of this arrangement is that if you intend to leave the computer disconnected from any power supply for extended periods, the battery will be used irrespective of whether you want to retain the data or not. To prevent the battery from needlessly powering the circuit, it would be necessary to mount a switch on the back panel and use it to disconnect the battery.

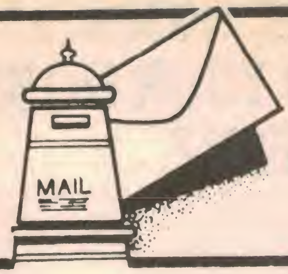
Construction

All of the wiring and components for the standby power circuit can be accommodated inside the back panel of the car computer. The battery is retained in position by a suitable clamp which can be made from a piece of scrap aluminium. The only other additions are a socket (to mate with the plug pack) and a three-way tag strip. The two diodes are mounted on the tag strip.

The cathodes of the two diodes are connected to the "12V" terminal, with one anode connected to the battery positive terminal and the other to the input socket positive terminal. The layout of components on the back panel will depend on the location of the existing connector, but you could use the accompanying photograph as a guide. Note that the battery must be mounted clear of the PCB pins.

To test the standby power circuit, all that need be done is to connect the computer to its normal power source, enter some data, and disconnect the computer. Upon re-connection, the data you have just entered should still be available.





Letters to the editor

Telecom and the Davidson Report

I would like to compliment you on your "Editorial Viewpoint" in the December 1982 edition of "Electronics Australia". Your comments on the Davidson report are both accurate and timely. If some of Davidson's recommendations are implemented Telecom's customers will indeed pay.

It is important to realise that at the moment Telecom does not sell a commodity. Telecom sells service. Your annual telephone rental is a fee for service. The telephone rental fee entitles you to any number of service calls without extra charge. Damaged wiring or equipment is replaced or repaired as often as required without extra cost. No extra charge is made for the man hours taken to restore service.

Davidson made three recommendations to change this:

- Recommendation 46: "Telecom's pricing policy should reflect costs to a substantial degree".
- Recommendation 20-21: "The private sector should be permitted to participate in all aspects of terminal equipment marketing . . . and wiring in customers premises".
- Recommendation 24: "Telecom's network interface should be at a junction box at the boundary of the customer's property or on the outside of the building as appropriate".

Davidson explains his intent as follows: "customers . . . make their own arrangements in their own time either to correct a faulty telephone in their own premises or to buy a new handset".

Now I wonder how many of Telecom's customers will think Davidson's alternative is preferable? How will they feel about paying rent to Telecom to maintain the service as far as their door and paying a contractor to repair their wiring and equipment? The contractor will charge a service call, an overtime rate where it applies, parts and labour.

Another very important point is the abolition of cross subsidisation of rural services. Why are rural services running at such a huge loss? Simple. In city areas a telephone exchange services thousands of customers. In a rural situation an exchange might serve as few as 30 customers. Still they are only charged the standard connection fee if they are within 16km of the exchange.

A typical example is the newly completed Hill End Rural Automatic Exchange, which serves only 78 customers. The cost to Telecom for external plant, installation of the exchange and conversion of subscribers equipment was close to half a million dollars. Yet customers within 16km of the RAX will be connected for the standard fee of $150.

Recently in the Dubbo district six new customers were connected to Telecom's network at a total cost of $20,000. Through cross subsidisation the cost to new customers was the standard $150. If Davidson has his way the cost to similar customers in the future will be nearer to $3,000.

Finally let's look at the effect on the country. Telecom has a "Buy Australian" policy. Over 80% of all goods purchased are bought here from private enterprise companies. Last year Telecom announced their intention to purchase $700 million worth of goods. By applying the 80% rule, $560 million would be ordered from local companies. In fact substantial contracts have already been let.

Davidson's recommendation 41: "Telecom should support the local (Australian) manufacturing industry only when it is in Telecom's commercial interest . . ." How un-Australian can you get? Just how many jobs outside Telecom does Telecom support? In the 1981/82 financial year Telecom poured $3.3 billion into the Australian economy. In addition to wages, payments to government authorities and interest on government loans, $920 million was paid to the private sector during 1981/82 — a healthy boost to local industry.

Now where will the money made by private (multi-national) companies go? If it follows the usual trend of their profits anything other than the essential costs will go out of Australia. In the prevailing economic climate does Australia need Davidson's recommendations? I don't think so.

R. W. Moffat,
Orange, NSW.

Axing commercials — times have changed

The project "Remote Infrared TV Sound Control" stirs an old chord. Policies have changed over the years. Nearly 30 years ago, I submitted a design of a device (valve) I had made to kill radio commercials automatically. The response from John Moyle, of revered memory, suggested that it wouldn't really do to publish it. I enclose a photocopy of J.M.'s letter.

The device really worked and it is only as recently as six or seven years ago I dismantled it (only listen to the ABC you see).

B. M. Byrne,
Indooroopilly, Qld.

John Moyle wrote as follows:

"Your exceptionally ingenious circuit arriving near Christmas time has placed far too much strain on my mentality for me to make any intelligent comments about it other than to applaud the principle. On his return from holidays I shall hand your letter to Mr Williams who I am sure will not only be highly interested in it but will probably deal with it in his inimitable manner.

I doubt whether we could feature such a device in one of our designs for at least two of the local "B" class station engineers are very big men and would probably appear on the doorstep with axes. Thank you very much for the letter and good wishes."

COMMENT: Times do change. We now feel that the big men with axes have probably grown frail.

Follow-up on electronic power meter

I wish to advise you of information this company received from the Energy Authority of NSW regarding an electronic power consumption meter.

The letter from this company published in December EA indicated a slow response to our enquiry, however after they contacted us arrangements were made for a discussion to take place. A representative from the Authority explained the many problems they were coping with at that time which led to the delay.

After this the Authority was most helpful in providing information to us and is doing quite a deal of research into the area of power metering. I hope this letter clarifies the situation.

D. Hughes,
Technical Consultant,
Paltronix Pty Ltd,
Wollongong, NSW.

(letters continued on p115)

SO PURE, IT'S WICKED

The ETI 5000 System. Pristine. Pure. Cocaine for the ears.
And to think that they are Australian made and designed. They can stand comparison with any kit or ready-built available — anywhere. In fact we still think that they are the world's best amplifiers. We should be justifiably proud of this achievement in Audio.

$319

"BLACK MONOLITH"

REF: ETI JAN/MARCH 1981

Cat. KE4200

The ultimate Hi-Fi power amplifier. We call our model the "Black Monolith" because we feel that the name symbolises the intelligence that went into the design.
The Jaycar "Black Monolith" is without doubt the best kit of the project available. If you have doubts ring our Managing Director, Gary Johnston and he will tell you! (Be prepared for a long conversation).
Several kit suppliers now have 'versions' of the original 5000 P.A. which claim to be similar to ours. This is simply not the case.
Space does not allow us to show EVERY refinement that has been made to the 5000 but notable ones are.

EXCLUSIVE FEATURES.
- Rear panel mains fuseholder
- 1% METAL FILM resistors used
- Flux shorting strap on power transformers
- Original chassis bar design
- Beryllium Oxide (Space Age Ceramic) TO-3 washers. (NOT flimsy Mica)
- Jig drilled and extruded heavy gauge, anodised heatsink bracket
- SUPERFINISH front panel. STILL THE BEST now with blind tapped holes
- New heavy duty heatsinks for the driver transistors. 100% extra heatsink area and black anodised for greater efficiency (NOT in original design)
- Ventilation holes in metalwork at critical points (NOT in original design)
- Extra 3 pin DIN socket on rear panel (total 2) to power new 5000 components

IF YOU THINK THAT YOU CAN SAVE MONEY ON THESE KITS ASK YOUR SUPPLIER IF HE WILL GIVE YOU ALL OF THESE FEATURES AT THE PRICE. MAKE SURE THAT YOU GET IT IN WRITING!! (Write for new glossy leaflet (SAE))

SPECIFICATIONS

POWER OUTPUT	Around 100W RMS into 8 ohms
FREQUENCY RESPONSE	8Hz to 20kHz, +0 – 0,4dB 2,8Hz to 65kHz, +0 – 3dB Note: these figures are determined soley by passive filters
INPUT SENSITIVITY	1V RMS for 100W output
HUM	– 100dB below full output (flat)
NOISE	–116dB below full output (flat, 20kHz bandwidth)
2nd HARMONIC DISTORTION	<0,001% at 1kHz (0,0007% on prototypes) at 100W output using a ±56V supply rated at 4A continuous <0,003% at 10kHz and 100W
3rd HARMONIC DISTORTION	<0,0003% for all frequencies less than 10kHz and all powers below clipping
TOTAL HARMONIC DISTORTION	Determined by 2nd harmonic distortion (see above)
INTERMODULATION DISTORTION	<0,003% at 100W (50Hz and 7kHz mixed 4;1)
STABILITY	Unconditional

We regret to advise that among other things, metalwork and sales tax increases have forced us to increase our prices slightly. Whilst we could have kept our costs down by using inferior components, we refused to take this course of action.

5000 SERIES GRAPHIC EQUALISERS

Latest addition to the thoroughbred 5000 Series stable! David Tillbrook has once again produced a 'No Compromise' design. This new component, a 1/3 octave equaliser gives you ABSOLUTE CONTROL over the acoustics of your particular listening enviroment. You get 3 SEPARATE CONTROLS for every octave of audio bandwidth to virtually eliminate the subtle nuances that are particular to your listening area.
1/3 octave equalisers have been used by professional engineers in Recording Studios and Live Concerts for over a decade now. It is no accident that the advent of the 1/3 octave equaliser and studio quality live sound have gone hand-in-hand. BUT THERE'S A CATCH. One of these equalisers is not enough. You will have to buy 2 (for stereo). Quite a lot of money — but worth it if you want the best. The Jaycar kit includes a fully pre-punched plated chassis, pre-punched heavy gauge front panel with silkscreened front panel to match the other 5000 components. It is absolutely original. You can purchase the kits one at a time for S199 each or, for two, S389 — a S10 saving. If you are one of the hundreds of happy 5000 users we are convinced that you will be just delighted with this unit.

SPECIFICATIONS:
Signal-to-Noise: –102dB with respect to 1 Volt
Frequency Response: 12Hz — 105kHz to –1dB
Boost/Cut: 14dB (28dB total)
Distortion: 100Hz-0.007%, 1kHz-0.007%, 10kHz-0.008% (essentially irrepective of cut or boost)
Current consumption (DC) Approx 100mA @ ±15V (Requires 30V AC CT)
Output short-circuit proof.

$199

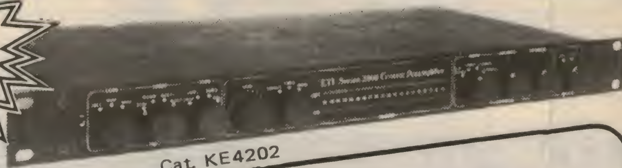
BUY 2 AND SAVE $10 — ONLY $389

AUSTRALIAN (NOT HONG KONG) MADE — SPECIAL BUILT RACK CABINET — QUALITY!!!

ALL IC SOCKETS PROVIDED

Cat. KE4204

$299



Cat. KE4202

"BLUEPRINT"

"One Swallow does not make a spring"
— Neither does a few gold RCA sockets!
Several of our competitors are imitating our "Blueprint" preamp by adding a few bits and pieces, notably gold plated RCA sockets to their standard kits. Unfortunately they have missed the point. We supply gold plated sockets in our "Blueprint" preamp but only where it makes sense to do this, i.e. on the inputs — NOT the outputs. 16 gold sockets are provided by us. This, however, does not make a "Blue print". THIS DOES
- Low capacitance screened cable 12 metres of it. NOT Taiwanese cable as supplied in other kits. Our cable costs us NEARLY 5 TIMES MORE than the Taiwanese stuff
- Original ETI designed front panel. Not an "ADAPTION". Our front panel is by far the nicest.
- Factory pre-tinned PCB's to reduce chances of dry or noisy solder joints.
- Quality LEDs, polished finish, multicoloured display
- IC sockets on line amp board.
- Special rear panel.
- Special low noise selection LM394H NOT CH device in M C preamp
- Thermalloy (U.S. made) heatsink on 7805 regulator.
- English Lorlin selector switches.
- Apart from the 16 gold RCA's we throw in a pair of gold plated line RCA plugs — worth S5.
- Special Nylon rear panel grommets.

So don't "Swallow" the facts before they are properly digested!!
You can't make a silk purse out of a sow's ear. Send SAE for full specs.

FUNCTIONS
- MOVING COIL INPUT
- MOVING MAGNET (DYNAMIC CART)
- INPUTS (2 OFF)
- TUNER INPUT
- AUX INPUTS (2 OFF)
- TAPE INPUTS (2 OFF)
- INPUT LEVEL CONTROL
- TAPE OUTPUTS (2 OFF)
- 400Hz CALIBRATION OSCILLATOR
- LED AVERAGE (VU) & PEAK
- LEVEL METERS –48dB TO +9dB
- MODE SWITCH STEREO
  BALANCE CONTROL
  LINE OUT MONITOR OUT
  MONITOR VOLUME CONTROL

FEATURES
- EXTREMELY CLOSE TRACKING TO RIAA PHONO EQ
- GOLD PLATED CONNECTORS ON ALL INPUTS
- ENGLISH 'LORLIN' LOW NOISE SELECTOR SWITCHES
- LOW NOISE 1 50ppm METAL FILM RESISTORS USED
- TINNED FIBREGLASS PCB's
- LOW CAPACITANCE SCREENED CABLE USED THROUGHOUT
- QUALITY IC SOCKETS
- SPECIAL REAR PANEL
- MULTICOLOURED RECTANGULAR LEDs USED

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ALTRONICS ... ALTRONICS ... ALTRONICS ... ALTRONICS ...

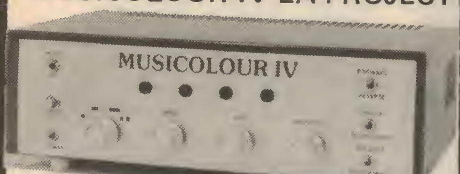
EA DRILL SPEED CONTROLLER MK II

For Universal Brush Type Motors Drawing up to 3 amps.

Varies motor speed from a few RPM to full speed while maintaining good torque. Suitable for:— Drills and Drill Presses; Circular Saws; Jig Saws; Food Mixers; Movie Projectors. ALTRONICS Kit is complete with mains flex and plug and is supplied with Jiffy Box and solid steel front panel.

K 6005 . . . . **VALUE $13.95**

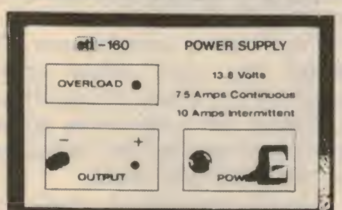
THE EVER POPULAR MUSICOLOUR IV EA PROJECT



Combination Colour Organ and Light Chaser. Four channel colour organ. Internal microphone or connect to speakers for colour organ operation. (The lights connected to each channel pulse in beat to the music proportional to portion of frequency spectrum concerned.) Four chaser modes forward and reverse. Output lamp load capacity a massive 2400 watts — that's 100 party globes. Full instructions and every last nut and bolt included. Great for parties, shop signs, display windows etc.

K5800. . . . . **$89.50**

13.8V HIGH CURRENT SUPPLY



(See ETI JULY 1982)

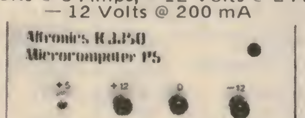
- Output voltage — 13.8 Vdc.
- Output current — 7.5A continuous 10A intermittent
- Regulation — 0 to 7.5A : 50MV

Save the expense of a mains powered rig. Kit complete in every way.

K3250. . . . . **$84.00**

ALTRONICS K 3350 MICROCOMPUTER POWER SUPPLY

+ 5 Volts @ 3 Amps, + 12 Volts @ 2 Amps, — 12 Volts @ 200 mA



This universal computer power supply is based upon an EA design. (Our version is uprated).

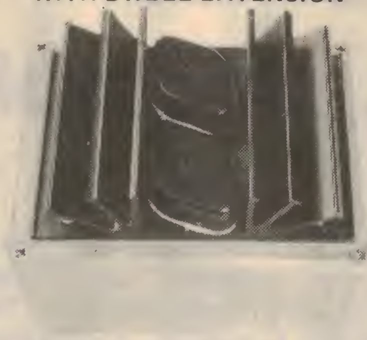
+ 5 Volts for memory, CPU all Micro's.
+ 12 Volts for RS232 interfaces etc.
— 12 Volts handy for additional hardware using OP Amps.

- Uses TO-3 Regulators + 5 V and + 12 V.
- Heavy Duty Fan Type Heatsink.
- Complete Boxed Kit with Delux Front Panel.

NOTE: This unit has enough grunt to power most small disk drives.

K 3350 **$59.50**

TRANSISTOR ASSISTED IGNITION WITH DWELL EXTENSION



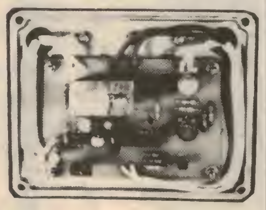
The Altronics Kit includes all components for the modifications, detailed by Electronics Australia Feb. 1983.

Yes, it's bad enough paying $2.00 a gallon for petrol without wasting a fortune on an out of tune engine. Fit this transistor assisted ignition kit in minutes and start saving money from the very next petrol stop. Easy to build!

K 4010 . . . . **$35.00**

CURRENT TRIP CAR ALARM

Exit / entry delay
No false alarms
State of the Art
Design by ETI



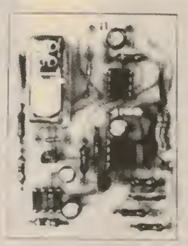
Protect Your Valuable Car and Contents

Circuit detects minutest voltage drop across vehicle's battery earth strap, tripping the alarm ★ uses Milspec LM394 ★ Quality diecast box ★ genuine fujitsu relay ★ automatic reset after pre set time period ★ installs in minutes ★ includes dash mounting LED-flashes to deter thieves.

K 4330 . . . . **$29.50**

CAR ALARM ETI 084

A staggering number of cars are stolen each year. Install an Altronics Alarm Kit and yours won't be one of them.



Circuit operates by detection of voltage drops in the electrical system and features a flashing LED for dash mounting as a deterrent to would be vandals and thieves.

K 4084 . . . . **$12.00**

BATTERY CONDITION INDICATOR

Ingeniously simple circuit indicates battery low-okay-overcharging, ETI Kit

An Investment Against the Cost of a New Battery

K4320. . . . . **$4.95**

EXPANDED—SCALE LED VOLTMETER

HAS MANY APPLICATIONS

ETI design suitable for lead-acid wet cells, lead acid gel electrolyte, vented nickel cadmium types and so on and so on.

Unit covers range of 10.5v to 15v

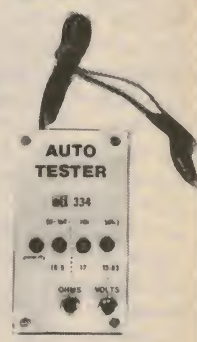
Determine battery condition instantly

Easy to Build!

K4326. . . . . **$9.50**

ETI "AUTO TESTER"

Handy little test gadget will enable you to check voltage drops, on/off battery charge voltages and resistances in any vehicle electric systems.



Unit indicates: reversed polarity ★ voltage drops of 0.5V or less ★ voltage between 12V and 13.5V ★ voltages above 13.5V ★ resistance below 150R ★ resistance 10K or above ★ resistance 50K or above.

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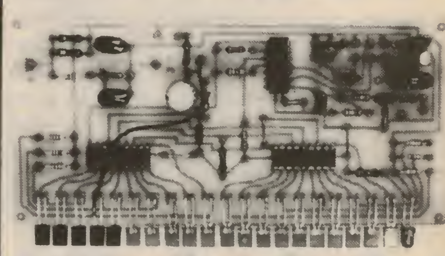

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Basic Electronics

Design & build your own solenoid

While most readers probably understand the general concept of a solenoid, few people have ever bothered to acquaint themselves with the theory or attempted to build their own. This article gives you some of the theory and shows you how to build a practical solenoid.

by JEFF SKEEN

The shape of the magnetic field surrounding a bar magnet is probably familiar to most people. A demonstration of the shape of this field using iron filings and a cardboard sheet seems to be a standard feature of science courses in secondary schools. Often the demonstration is extended slightly to show that a long coil of wire with DC current passing through it shares the same shape of field as the bar magnet.

This coil of wire is called a solenoid, which is defined by the Chambers Dictionary of Science and Technology as: "A current-carrying coil, of one or more layers. Usually a spiral of closely wound insulating wire, in the form of a cylinder, not necessarily circular. Generally used in conjunction with an iron core, which is pulled into the cylinder by the magnetic field set up when current is passed through the coil."

The third sentence of the definition concerns us the most for this is the form our solenoid will take. We use the magnetic field of the solenoid to perform work on a steel rod which in turn either operates or is part of the mechanism of a simple machine. To understand how the solenoid can move the rod and how much force the rod will apply to an external device, we require a knowledge of the basics of electromagnetism.

When dealing with electromagnetism, it is fairly common to use an analogy with electric circuits to help understanding. Since the concepts of voltage, current and resistance are familiar and easy to understand, similar concepts are used for magnetic "circuits". In magnetics, the driving force or "voltage" which creates the magnetic field is a function of the electrical current and the number of turns of wire. It is called the mmf (magnetomotive force) and given the units, ampere-turns.

Similarly, current in a magnetic circuit is called flux (measured in webers) and magnetic resistance is called reluctance (measured in Henrys $^{-1}$). These terms can be be put together to form a sort of magnetic equivalent of Ohms Law.

Therefore, just as we write emf = current x resistance for the electric circuit, we can write mmf = flux x reluctance for the magnetic circuit.

The reluctance *(R)* of the magnetic circuit is calculated in terms of its magnetic length, area and conductivity (ℓ_m, A_m and $\mu_o \mu_r$ respectively). Thus:

$$R = \ell_m / A_m \mu_o \mu_r$$

(strictly speaking, $\mu_o \mu_r$ is termed magnetic permeability rather than

Most of the parts will be available from the garage junkbox.

magnetic conductivity). μ_o is a constant called the permeability of free space and has the value $4\pi \times 10^{-7}$ H/m. μ_r is the permeability of the materials through which the flux is flowing.

Usually μ_r has a value around 1, the exception being the ferromagnetic class of materials such as iron, nickel, etc (and their alloys) which can have μ_r values approaching 1×10^6. Since μ_r is a conductivity measurement, a high value indicates that the material presents very little resistance to the passage of flux and is therefore a good magnetic conductor.

Iron transformer laminations and other iron pieces do not have μ_r values this high, a typical value being closer to 1000. This means that air, with a μ_r value of 1, forms a poor magnetic insulator around the iron and flux leakage through the air can be significant. This can prevent a simple analysis of the magnetic circuit since it is usually very difficult to determine the precise value of the leakage flux without first building and measuring the circuit!

Usually some assumptions about leakage flux and other uncertain parameters are made during the initial calculations and these values are subsequently corrected in later calculations as more data comes to hand.

To start our analysis of a solenoid we begin with the simplest case, that of a single loop of wire suspended in air. Since air has a μ_r which equals one the term $\mu_o \mu_r$ can be simplified to just μ_o. The magnetic field strength (H) along the axis of the wire loop can be determined using calculus, and is equal to I/2r, where I is the current in the wire and r is the radius of the loop.

If we cascade the wire loop to form a long air-cored solenoid, the formula for the magnetic field strength becomes, H = NI/ℓ. where N is the number of turns in the solenoid, I is the current passing through the turns and ℓ is the length of the solenoid.

Since the amount of magnetic pull we can create with the solenoid is related to the field strength, the above formula tells us how we should wind the coil. The length term in the denominator should be made as small as possible in order that the field in the centre of the coil be as large as possible. This indicates that a short fat coil will produce more

field strength than a long skinny coil.

The disadvantages of a short, fat coil are that it will only exert a strong force over a short distance, and that the outer turns use proportionally more wire per turn than do the turns on a thinner coil. On the other hand, the long solenoid while acting over a greater distance, will produce less pull and may need more turns to compensate for this.

The trick then, is to balance the coil dimensions and produce a coil with enough pull over the required distance while using the least wire.

By now some readers will be saying "why not encase the coil in an iron jacket so that the flux does not have to pass through the high reluctance of the air?" This is precisely what we do as our next trick for increasing the field strength. The net increase in field strength, however, is not as strong as we might first expect due to the behaviour of the field when outside the solenoid.

As the flux emerges from the centre of the solenoid it spreads out (in theory to infinity) into the surrounding air. Although air has a high reluctance, the flux is travelling through such a large area that the effective reluctance becomes quite low. The electrical anology of this is with wire, where a large cross sectional area will have less resistance than a small cross sectional area of the same wire. The use of an iron jacket therefore, does not produce the large decrease in reluctance (with attendant increase in field strength) one would first suppose.

The use of a jacket does however produce a neat unit which can be clamped into position with "U" brackets. This allows the solenoid to be used for projects such as electronic locks where the ability to mount the lock securely on or in a wall is a must.

The end cheeks of the coil are used to prevent the wire from unravelling and to provide a low reluctance path for the flux, away from the bottleneck of the solenoid core. In addition, the solid end-cheek forms a magnet which locks the metal bolt into position when the power is applied.

By making a few assumptions about the magnetic flux path around the

PARTS LIST

1 100g spool of .5mm enamelled wire
1 15cm length of 12mm aluminium tubing
1 steel bolt, 70mm long, 9mm diameter
1 threaded female waterpipe coupling, 40 x 25mm
1 piece of galvanised iron sheet, 100 x 100mm

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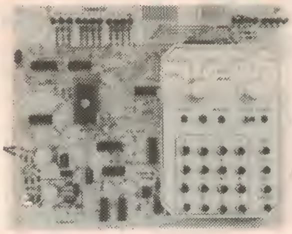

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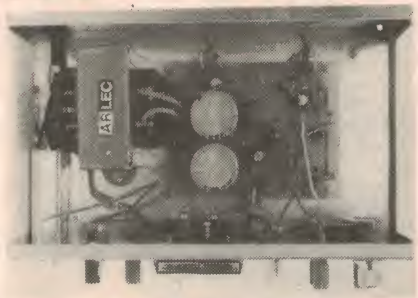

Built around positive and negative 3-Terminal Regulators, this versatile dual tracking Power Supply can provide voltages from ±1.3V to ±22V at currents up to 2A. In addition, the Supply features a fixed +5V 0.9A output and is completely protected against short circuits, overloads and thermal runaway. **EA March 82**

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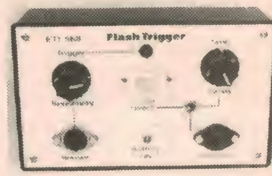
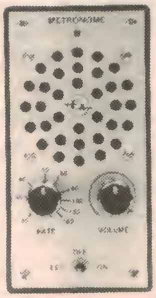


Catch those spectacular and humorous moments like that time your mother-in-law slipped on the moss covered patio and broke her neck. **ETI 568 October 80**

ELECTRONIC METRONOME



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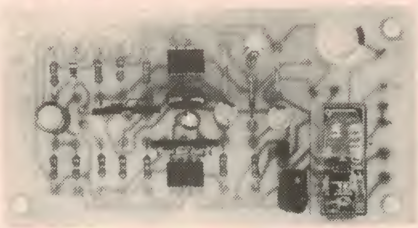

EA's great new Voice Operated Relay can be used to control a tape recorder, as a VOX circuit for a transmitter, or to control a slide projector. **EA April 82**

LED LEVEL METER

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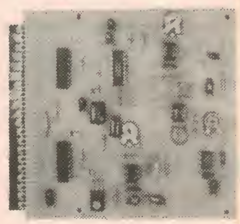

Build a Led level Meter with simultaneous peak and average display plus 60dB dynamic range. This kit is ideal for any application requiring a wide dynamic range level display. **ETI 458 June 81**

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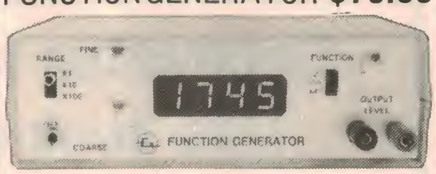

This Function Generator with digital readout produces Sine, Triangle and Square waves over a frequency range from below 20Hz to above 160kHz with low distortion and good envelope stability. It has an inbuilt four-digit frequency counter for ease and accuracy of frequency setting. **EA April 82**

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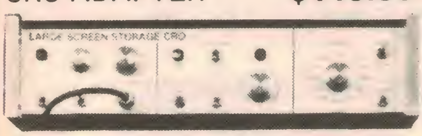

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ETI October 81

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solenoid, an estimate can be made of the pull required to separate the bolt from the bottom end cheek. The assumptions are: that all the flux flows through the iron and none through the surrounding air, that there are no airgaps between iron pieces, that the μ_r (permeability) of the iron is 1000 and that none of the iron pieces carry so much flux that they saturate.

The assumptions are of course incorrect, but they do give us a maximum value of force which we could achieve with our present setup if conditions were ideal.

Using the following data from our prototype solenoid:
Number of turns, N; 1000
Magnetic path length, l_m; 11cm
Current, I; 2A
Cross sectional area of bolt, A; $6.36 \times 10^{-5} m^2$
the magnetic field strength (H) was calculated to be:

$$H = NI/\ell_m$$
$$= (1000)(2)/(0.11)$$
$$= 1.82 \times 10^4 \text{ A/m}$$

From this the force (F) holding the bolt to the end cheek is:

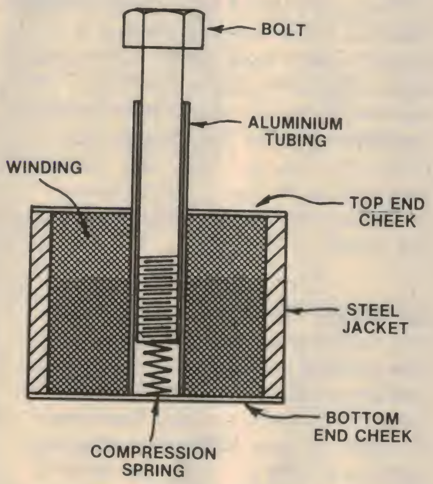
$$F = H^2 A \mu_o \mu_r / 2$$
$$= (1.82 \times 10^4)^2 (4.5 \times 10^{-3})^2 \pi (4\pi \times 10^{-7})(1000)/(2)$$
$$= 13.21 \text{ Newtons}$$

In the old Imperial system this is equivalent to a force of 3lb. In practice we could suspend just on 2kg (about 4.5lb in the old units) with our prototype.

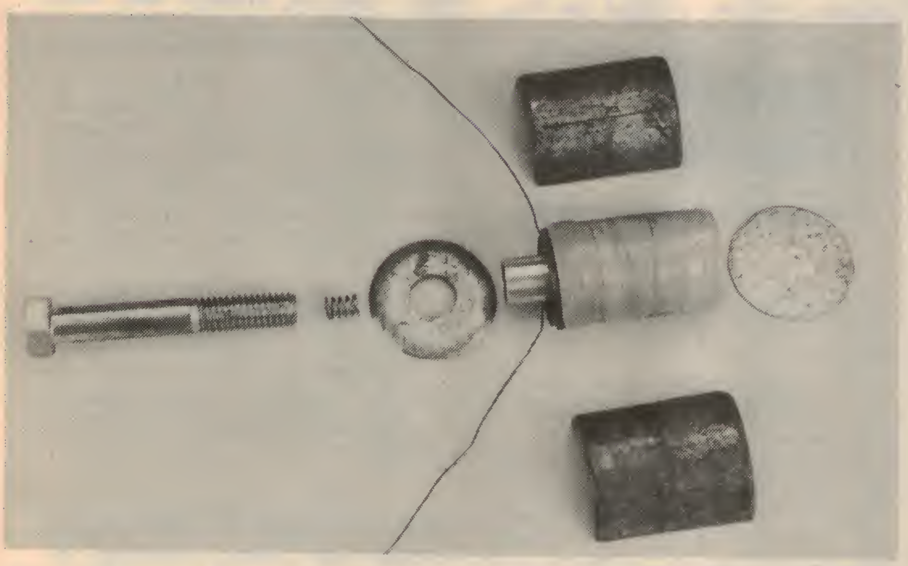
If a compression spring is included between the bolt and the end cheek, there will be less force developed due to the high reluctance of the airgap around the spring. The best spring to use is one which will compress very flat, resulting in the least gap between the end of the bolt and the end cheek.

The solenoid has been designed to work with a 12V power supply capable of delivering 2A. If no supply is available, a 12V car battery will suffice. Lower voltages can be used, however the force developed on the bolt will be correspondingly less.

The coil is wound around a piece of 12mm (outside diameter) aluminium tubing. This tubing was selected since it provides a reasonable fit for a 9mm bolt. There is no reason why other diameters of tubing cannot be used provided they are made from a non-ferrous material. It is not advisable to use plastic tubing since the heat generated in the solenoid may melt the plastic if the solenoid is operated for longer than a few seconds.



The assembly details are shown in this cross-section diagram.



This view shows the various parts of the solenoid prior to assembly.

The outer jacket of the solenoid was constructed from a threaded female coupling normally used to connect two pieces of water pipe together. The coupling is made of galvanised steel with a length of 40mm and an inside diameter of 25mm.

The end cheeks of the solenoid are produced by cutting out three circular discs from a sheet of flat 24G galvanised iron with a pair of tinsnips. The discs should have a diameter equal to the outside diameter of the solenoid jacket. Two end cheeks should have a 12mm hole drilled through their centres to enable them to be slid over the aluminium tubing.

The two end cheeks with holes in them are now slid over the aluminium tubing and held 40mm apart by building up the diameter of the aluminium tubing on the outside of the cheeks with electrician's tape. The wire can now be wound onto the aluminium tubing between the end cheeks. If wound neatly it is possible to fit almost an entire 100g spool of 0.5mm wire into the solenoid jacket.

The easiest way to wind the wire is to place the aluminium tube in the chuck of a hand drill and then place the body of the drill in a vice. One hand can now be used to turn the drill while the other guides the wire. The high gear ratio of the drill will also make winding the wire much quicker. The wire should be built up until its diameter is just less than the inside diameter of the solenoid jacket. A layer of electrician's tape is now wound tightly around the wire to prevent it unravelling.

Carefully remove one of the end cheeks and place a piece of tape over the end of the coil to prevent turns falling off. Use a hacksaw to cut off the aluminium tubing flush with this end of the coil. Slide the solenoid jacket into position over the coil, then tape the solid end cheek to the exposed end of the coil. The other end cheek can now be taped to the jacket and the aluminium tube cut to a suitable length.

If a more permanent arrangement is required the end cheeks can be glued to the jacket with epoxy resin adhesive. The wires from the coil can be run out between the end cheeks and the jacket.

The solenoid is not intended to be run continuously for more than about 30 seconds at a time. About 25W is dissipated in the solenoid when it is operated from 12V and the resulting heat is far too much to be radiated from such a small package. This time limit is not really a disadvantage since in most applications, such as the mechanism of an electronic lock, the solenoid is only required to operate for short periods ➔

50 & 25 YEARS AGO

"Electronics Australia" is one of the longest running technical publications in the world. We started as "Wireless Weekly" in August 1922 and became "Radio and Hobbies in Australia" in April 1939. The title was changed to "Radio, Television and Hobbies" in February 1955 and finally, to "Electronics Australia" in April 1965. Below we feature some items from past issues.

Wireless Weekly 3d

March 1933

Tariff cut: On the eve of the Australian radio industry's great annual exhibition, the news that there is to be cut in the tariff on radio receivers has been received with mixed feelings.

An examination of the new schedule shows that the rate per socket on foreign receivers has been reduced from 30/- to 25/-, and on British receivers from 20/- to 12/6 per socket. The ad-valorem duty of 35% and 55% respectively remains the same.

☆ ☆ ☆

Gunnery radio: A unique series of transmissions took place on February 13 and 14 outside Sydney Heads when gun practice was in progress. The experiments were carried out by VK2HA who worked phone from the target ship for cast defence gunnery practice from South Head. 2HA is anxious to ascertain how the signals were heard in distant centres. The wavelength used was 40 metres. How many of our listeners heard the transmissions?

☆ ☆ ☆

Circuit expose: Students of radio theory and design are naturally keen to know something more about the exhibits than the colour of cabinets and so on. However, for the benefit of those interested we have taken a run around the factories and stands to see what makes the various sets play. From what we have been able to see we regret that there is nothing really startling. With all the modesty we can scrape together we may say that anyone who has studied our columns for the last six months knows all about the sets in the Show.

☆ ☆ ☆

Radio Inspector moves: Chief radio inspector (Mr Crawford), and the brilliant satellites of his department, are no longer to be found in the Southern City Telephone Exchange, in Castlereagh Street, next to the Fire Station.

The great cabinet containing nearly 200,000 radio listeners' names is no longer hidden from view, but stands against the far wall proclaiming to all visitors the impeccable honesty of the Australian listener, his integrity, loyalty to the Government, and faithful payment of taxation. Also, perhaps, his dislike and fear of prosecution in a law court.

☆ ☆ ☆

Live Steam: This is not a story at all — it is a dream; but a tea shop in Japan was infested with flies (like this story), and the proprietor released clouds of steam from kettles at opposite ends of the shop. One kettle was attached to the anode of a battery; the other to the cathode; when the positive jet of steam collided with the negative jet in the middle of the room the ensuing thunderstorm electrocuted the flies.

RADIO TELEVISION AND HOBBIES

March 1958

TV recording: Telerecording forms an important part of modern television programme techniques, for by this means, a programme can be transferred to film for use on subsequent occasions.

Basically, this is achieved by feeding the video signals and synchronising pulses to a cathode ray tube capable of producing an intensely bright, short persistance picture. This picture is optically focused on to a "frame" of negative film stock and thereby photographed, the film then being moved on one "frame" for taking of the next picture, and so on.

☆ ☆ ☆

Symphony telecast: In many ways the most interesting TV event of the month was the telecast of the Sydney Symphony Orchestra from the new studios of ABN.

Viewers were treated to a musical program, simultaneously broadcast from 2BL, and regaled with close-ups and odd angles of the players in action.

For those to whom such glimpses of the orchestra were new, no doubt the telecast was intensely interesting. The roving camera unearthed some quite surprising things about the players and their instruments.

But, pictorially, sooner or later they become a dead loss.

☆ ☆ ☆

Aero TV display: Constant efforts are being made to simplify the task of aircraft pilots, in the interests of both efficiency and safety. Stress is laid on presenting the pilot with information with less dependence on ground staff.

Test results indicate that TV-like flight data presentation will develop into a huge military and civilian business within a decade.

Present design uses a special-purpose, high-speed electronic digital computer to transform input data from conventional sensing devices into signals which generate pictures on two flat-screen, transparent cathode ray tubes.

☆ ☆ ☆

Radar traps: The Automobile Association, one of Britain's two road organisations, has objected to a police radar plan to detect vehicles exceeding the speed limit.

The instrument, to be used at selected points in London, is a radar speedmeter, an American invention which, by means of a beam from a patrol car, translates waves sent out by approaching vehicles into miles an hour.

An AA spokesman said the association's principal objection was that the instrument was unreliable.

They claimed it was impossible to identify a single vehicle from a number travelling past a given point together.

☆ ☆ ☆

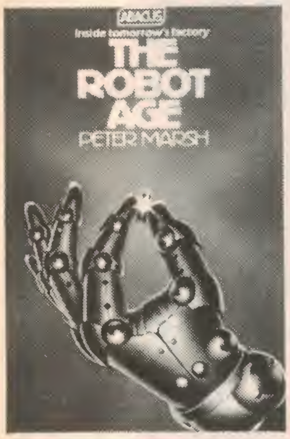
BBC tries stereo: The BBC recently carried out some interesting experiments with stereo transmission by broadcasting simultaneously the two channels from different stations.

The left hand speaker channel came from the TV transmitter at Crystal Palace, and the FM station on 91.3 MHz at Wrotham.

The right hand speaker channel was put over the Home Service from Brookman's Park on 330 metres and the FM Home Service from Wrotham on 93.5MHz.

Books & Literature

Robots and factories of the future



THE ROBOT AGE by Peter Marsh. Published 1982 by Sphere Books Ltd, London, UK. Abacus paperback, 183 pages, 132 x 198mm, illustrated with some photos and diagrams. ISBN 0 349 12287 3. Distributed by Thomas Nelson (Australia) Pty Ltd. Price $9.95.

While much has been written in recent years about robots and computers there is still a great deal of myth and confusion prevalent amongst many members of the public. This book should help improve that situation as it gives a very good historical perspective to the development of robots. Author Peter Marsh treats the subject with an English viewpoint which is appropriate since England was the country in which industrial development first began.

The theme that runs through Marsh's book is that England can only survive in the future by having a healthy secondary industry with substantial exports to the rest of the world. This must be, because England is not like Australia which has substantial agricultural and mining exports. Even so, there is a lesson here for Australia.

Marsh introduces the subject by giving the past history of industrial development which he splits up into three sections: the age of mechanisation from 1760 to 1840; the start of mass production from 1880 to 1920; and the entry of the computer from 1940 to 1980. He explains how England took the lead in industrial development and then lost it, first to America and then to Europe and finally to Japan.

From there on, the Author introduces robot concepts, including feedback, and explains the differences between automation and the applications of robots. Robot vision and touch are also discussed. Typical applications in factories are described and factories of the future are envisaged.

In summary, this is an ideal book for the non-technical reader. It is informative, balanced and easy-to-read. (L.D.S.)

Regulated Power Supplies

REGULATED POWER SUPPLIES by Irving M. Gottlieb. (Third edition.) Published 1981 by Howard W. Sams & Co, Indiana. Soft covers, 423 pages, 216 x 137mm. Illustrated with many circuit diagrams. ISBN 0 672 21808 9. Price $25.95.

Collected together in this book is probably everything you ever wanted to know about regulated power supplies and then some. In fact, such an enormous range is covered the book tends to neglect the finer detail at times. Although the book was written in America, most of the integrated circuits mentioned are readily available in Australia, and there should be no problem in duplicating the featured designs if required.

A brief summary of some of the more important topics covered in the book is as follows:

Chapter one covers reasons for using a regulated supply, types of supplies – voltage and current, applications of regulation techniques and types of supplies to suit certain applications such as microprocessors, high voltage equipment and uninterruptable (or no-break) systems.

Chapter two outlines static characteristics of regulated power supplies such as regulation, stability, protection techniques and cooling. A practical example of using a thermal circuit to calculate the required heatsink size is also given.

Chapter three examines the dynamic characteristics of regulated power supplies with sections on: dynamic output impedance, ripple, transient response and slew rate, radio frequency and electromagnetic interference generation and noise. There is also a very good section on suppression of noise spikes which has applications in many other places.

Chapter four covers the implementation of the previously discussed regulation techniques and presents basic circuits and design equations. A description of how the circuits work is also provided.

Chapter five is devoted to the principal components used in regulated power supplies. Included are sections on diodes (zener and Schottky), regulator ICs, Darlington transistors, MOSFETs, gate turn-off SCRs, power transistors and filter capacitors. Choke and inductor selection criteria are also covered.

Chapter six is titled "Linear regulating Supplies Using Integrated Circuits" and presents 50 pages of regulator circuits. Descriptions of how the circuits operate are given.

Chapter seven covers switching type regulators with an emphasis on high power designs. Most of these run directly from the mains and as such are not suitable for experimental power supplies. High frequency MOSFET designs are also included in this chapter.

Overall the book probably represents good value for someone who has the occasional need to design a power supply. Even if nothing fits the bill exactly, the numerous circuits presented in chapters six and seven are an excellent source of ideas and techniques for the design of a regulated supply.

Our review copy came from Jaycar Pty Ltd, 125 York St, Sydney. (J.S.)

Electronic Music

ELECTRONIC MUSIC SYSTEMS by Barry Klein. Published 1982 by Howard W. Sams & Co Inc, Indiana. Soft covers, 302 pages, 136 x 216mm. Illustrated with diagrams. ISBN 0 672 21833 X. Price $24.95.

This book, one of the Blacksburg Continuing Education series, provides up-to-date information on the design and construction of electronic music synthesisers in a clear and easily readable format.

Eight chapters are included, beginning with overall design considerations and moving on to power supply circuits, the application of control voltages, VCOs, filters, analog multipliers and delay lines and mixer circuits. The final chapter brings all the information together in the form of a construction guide for a modular synthesiser system based on the circuits described.

Two appendices are provided, one covering construction techniques and the second providing data sheets and pin-outs for synthesiser integrated circuits made by Exar, Signetics Corporation, Matsushita, Reticon, Curtis Electromusic and Solid State Micro

Technology. Some of these chips are available in Australia.

Throughout the book the text is supported by extensive circuit diagrams covering the use of the chips described, forming an excellent starting point for the constructor and experimenters. As with all overseas publications, some of the details of kit supplies and systems available "off the shelf" are not applicable in this country, but this aside the book can be recommended. (P.V.)

DATUM Handbook

WORKING WITH DATUM by M. R. Haskard. 210 x 298mm, soft covers, 86 pages plus listings and data sheets, illustrated with diagrams. Published by Techsearch Inc 1982 ISBN 0-909386-34-X.

This publication is a complete guide to the construction and operation of the DATUM microprocessor trainer featured in "Electronics Australia" from November 1982 to January this year.

The book begins with an introductory chapter covering microprocessors in general and continues with a guide to assembling and operating DATUM and a complete coverage, with examples, of programming and the 6802 instruction set.

Some, but not all of this material has been covered in "Electronics Australia" but is reproduced here in more depth and supported by further listings.

Separate chapters are provided on the DATUM Monitor program, the Motorola Peripheral Interface Adapter (PIA) chip and expansion of the basic DATUM board. Five appendices provide hexadecimal tables, a listing of the Monitor program, fault-finding and specifications and data sheets for the MC6802, MC6821 and MC6850.

All in all the book will be a valuable resource for the DATUM user. Our review copy came direct from the publishers, Techsearch Inc of the South Australian Institute of Technology, North Terrace, Adelaide, 5000, but they forgot to tell us the price. (P.V.)

Spectrum analysed

UNDERSTANDING YOUR SPECTRUM by Dr Ian Logan. Soft covers, 190 pages, 140 x 210mm, illustrated with diagrams. Published by Melbourne House (Australia) Pty Ltd 1982. Price $17.95. ISBN 0 86759 114 5.

The Sinclair "Spectrum" is yet to be officially released in Australia and we do not know when it will be. This book, hot off the presses covers the programming of the computer in both Basic and machine code.

Without having used the Sinclair machine, the book seems fairly complete, providing extensive details of the Basic dialect, machine code monitor routines and use of these routines in programs. Memory assignments and Basic token storage are discussed in detail and four appendices cover the Z80 machine code instructions, decimal to hexadecimal conversion, a list of current machine code handling programs and a section entitled "Spectrum Bugs".

When Sinclair's "Spectrum" is released here this book will be a useful guide to programmers wishing to make full use of the facilities which the machine provides.

Our review copy came from McGills Authorised Newsagency, 187 Elizabeth St, Melbourne, Vic, 3000, and the book is also available from Jaycar Pty Ltd, 125 York St, Sydney, NSW, 2000. (P.V.)

Memory manual

MOTOROLA MEMORY DATA MANUAL: Published by Motorola Inc, 1982. Soft covers, 180 x 232mm, 330 pages. Price $7.95.

This data manual covers memory devices made by Motorola Inc including TTL RAM and PROM, MOS static and dynamic RAM and EPROMs, including the latest 64k x 1 dynamic memory devices, 8K x 8 EPROMs and Electrically Erasable Programmable Read Only Memory (EEPROM), available from Motorola in 256 x 8, 2K x 8 and 32 x 32 bit versions.

Our review copy came from Paris Radio Electronics, Shop 1, 165 Bunnerong Rd, Kingsford, NSW, 2032. Phone (02) 344 9111.

Fairchild selection guide

A short form component selection guide is now available free of charge from Fairchild distributors. The 28-page guide covers TTL, CMOS and MOS integrated circuits, voltage regulators and linear devices, transistors and opto. electronic components. Distributors include George Brown & Co, Ellistronics, Rifa and David Reid (New Zealand).

LETTERS . . . *from p104*

The Wireless Telegraphy Act

In your January, 1983 article "Scanners and Scanning" you posed the question "Is it legal?"

It seems to me that it would be at least equally valid to pose the question "Is the Wireless Telegraphy Act of 1905, or any other Act of the Commonwealth of Australia relating to the transmission or reception of radio signals, constitutional?"

As far as I can determine from reading the Constitution the only section under which the Commonwealth may claim to have the power to pass an Act relating to radio transmissions is Section 51(v) which grants power with respect to "Postal, Telegraphic, Telephonic and other like services".

If I am correct the point at issue is as follows: "Is radio communication and broadcasting a service like the postal, telegraphic and telephonic services of 1901?

I would like to point out that S.69 refers to the transfer to the Commonwealth of the State departments of "Posts, telegraphs and telephones" among others. To me this indicates that the framers of the Constitution were considering the providers of Government communication services.

I contend that S.51(v) refers to public (probably government funded/supported/subsidised) communications between individuals or subscribers to those services. I further contend that it is not intended to control the flow of information whether by speaking in public, publishing newspapers or books, using pigeons or transmitting radio signals.

Having said all this, I do not want to be accused of being an anarchist. I fully realise that frequency allocations are a scarce resource and need to be controlled by the government (which is — or should be — the people) in the same way as a decision must be made as to on which side of the road we must drive. However, it appears to me that at present the Commonwealth of Australia does not actually have the power under the Constitution to control the transmission or reception of radio signals any more than it has power to control other forms of electromagnetic radiation such as light or X-rays.

I do not doubt that this power, if it not vested in the Commonwealth under the Constitution, resides with the States. Therefore as a first step to replacing (or validating) the Wireless Telegraphy Act of 1905 it will be necessary for the Commonwealth to request the States to cede to it their powers to control deliberate radiation (and reception?) of at least part of the electromagnetic spectrum.

P. B. Taylor,
Box Hill North, Vic.

ROBOTICS

JAYCAR – FIRST IN AUSTRALIA WITH THE VERY LATEST IN THE FIELD OF ROBOTICS

Jaycar is the first major electronics company in Australia to stock useful robots in kit and built-up form. Shown below are two models destined to become standards.

MICRO GRASP

ONLY

$499

The Micro Grasp is the first low-cost true robot. Basically the unit has an articulated arm jointed at the shoulder, elbow and wrist positions. The entire arm rotates on its base and has a motor driven gripper on the end of the arm. Each of the arm movements is SERVO CONTROLLED i.e. there are position sensors feeding back information to the interface board where it is compared with the programmed in intended position. Any positional error is automatically and continuously corrected. This servo action is independent of the computer, simplifying greatly the software to drive the robot. All programming is carried out with a small number of common BASIC commands. The interface board is memory mapped using only 64 Bytes at any of the 1024 switch slectable locations.

Control of the Micro Grasp as a computer peripheral is accomplished thru the parallel expansion part of most small computers. To keep the cost to an absolute minimum and to increase the learning factor the Micro Grasp is supplied as a self-assembled kit. All components down to the last nut and bolt are included, as is the power supply.

MICRO GRASP KIT INCLUDING POWER SUPPLY Cat. XR1000 – SPECIAL INTRODUCTORY PRICE $499.00

UNIVERSAL COMPUTER INTERFACE BOARD (in kit form) Cat. XR1010 ONLY $179.00

23 + 23 way edge connector at $9.95 ZX-81 peripheral/RAM pack splitter board $10.95

CALL IN TO OUR YORK STREET SHOWROOM AND SEE WORKING!!

GENESIS P~102

The P-102 is a much larger robot capable of lifting a 2Kg object and replacing it in an almost unlimited number of locations with great positional accuracy.

FEATURES: – Low cost for this degree of sophistication. – Six axis control – Positional sensing – Continuous path motion – Microprocessor controller included – Learning ability – RS232C computer interface – Almost infinite number of step sequences – Weight 34Kg – Hydraulic operation.

The P-102 is avialable in either kit or built-up form.

KIT – Cat. XR1200 $4999.00

Built, tested and guaranteed – Cat. XR1210 $5499.00

(These prices DO NOT include sales tax which, if applicable is 20%)

For further information on the P-102 send SAE.

New Products . . .

Product reviews, releases & services

Versatile function generator from Parameters

A new function generator from Parameters Pty Ltd provides frequency coverage from .001Hz to 5MHz in eight ranges. Designated the Model 3030, the B&K Precision instrument provides selectable sweep times from 10ms to 100 seconds and linear and logarithmic sweep operation selectable by a front panel pushbutton.

For applications which require an unusual wave shape, a variable symmetry control allows the shape of any waveform to be altered from 5% to 95% of the duty cycle, allowing the square wave output, for example, to generate rectangular waves or pulses, or the effects of harmonic distortion to be simulated.

Sine, square and positive and negative going ramps can also be selected by using a combination of three function buttons and the symmetry control. In all, seven of the most commonly used waveforms are generated by the 3030. Open circuit output is 20V peak to peak or 10V into a 50Ω load. Three attenuator switches provide calibrated attenuation in 10dB to 60dB steps while another control provides continuously variable attenuation to 20dB.

In addition to conventional function generator applications, the 3030 can be used to generate tone burst signals for audio speaker tests, TIM distortion tests in amplifiers, communication systems decoder alignment and other specialised applications.

Additional versatility is provided by a variable DC offset control with built-in protection circuit.

Because of its versatile capabilities, the B&K-3030 is well suited to a wide range of applications.

For further details contact Parameters Pty Ltd, PO Box 573, Artarmon, NSW, 2064. Phone (02) 439 3288.

New series of switches from Associated Controls

Associated Controls has been appointed the Australian distributor for the MEC 75 range of modular switches and keycaps, known as UNIMEC, a new type of miniature pushbutton switch for printed circuit board mounting.

The keyswitches offer six different types of switch functions, selected by connections to the appropriate key terminals when the switches are mounted. Applications include industrial equipment, games and professional keyboard products. In fact, the UNIMEC system can replace up to five different switch types with resulting savings in inventory and bulk purchasing.

The switches can be used in any configuration including vertical or horizontal rows or keyboard arrangements, and are shaped to help centre the finger on the button for smooth operation. Switches can be mounted on 2.54mm grids in any configuration and LED illumination is also offered.

Also from Associated Controls is a miniature rotary DIP switch, employing fully sealed construction and compatible with automatic assembly equipment.

For further information contact Associated Controls, PO Box 21, Padstow, NSW, 2211.

Zero voltage switching optically coupled Triacs

TRW Optoelectronics has announced a new series of optically coupled zero voltage crossing Triac drivers intended to be used for control of Triacs switching resistive, inductive and capacitive loads in 220VAC lines.

The three devices in the 220VAC range (there is also a 120VAC range) have LED drive currents of 30mA, 15mA and 10mA and will not turn on at voltages in excess of 25V. The advantages of zero crossing switching include longer load life and reduced amplitude of line peaks since the full line voltage will not appear across the load when the Triac turns on. As a result, both power line and radiated interference are minimised.

In addition to their role as power Triac drivers, the devices can be used as low level Triacs for driving small AC loads, warning lamps and display alarms.

TRW products are distributed by Total Electronics, 9 Harker St, Burwood, Vic 3215. Phone (03) 288 4044.

Wattmaster Alco digital time switch

Wattmaster Alco Pty Ltd has launched the latest in its lineup of digital time switches, the "Digi 16". This model is designed for controlling air conditioning installations where fans and chillers are required to be switched at different times.

Programs operate on a Monday to Friday and Saturday/Sunday schedule and two different programs can be incorporated in each of these schedules, on both channels, giving a capacity of 16 complete switching programs and 56 switching operations.

Time and memory are protected for ten hours in event of power failure by a rechargeable nine volt battery. Indicator lights show when channels are switched and which time schedules are operating.

For further information contact Wattmaster Alco Pty Ltd, 11 Rachael Close, Silverwater, NSW, 2141. Telephone (02) 648 1332.

Tandy introduce compact emergency transceiver

Tandy Electronics has introduced a CB radio "for people who don't like CB radio".

The Realistic TRC-411 is a 40-channel two-way radio that comes in a small carrying case that can be stowed in the glove box or under the seat of a car until it is required. A telescopic antenna with a magnetic base attaches to the roof of the vehicle and power is supplied by a plug to the cigarette lighter socket.

A single switch places the user on the CB emergency frequency, which is monitored 24 hours a day in most areas by volunteer radio operators belonging to organisations such as CREST. Assistance in breakdowns and accidents is readily obtained through the organisation.

The TRC-411 also functions as a standard 40-channel installation, and is said by Tandy to be particularly useful for those who want CB communications in a rented vehicle, or in handy portable form. Retail price is $149.95 from all Tandy stores.

Jaycar kit for Playmaster Hifi AM tuner

Jaycar Pty Ltd has submitted for review a sample of the company's kit for Playmaster Hifi AM Tuner. A major feature of the kit is the very well-finished front panel. This is made of 12-gauge aluminium and features silk-screened light-green lettering on a black anodised background for a professional finish.

The kit arrives neatly packed in a cardboard carton with ample packing to prevent components from being damaged in transit. According to Jaycar, it is complete to the last nut and bolt and even includes adequate lengths of solder and hook-up wire. The three printed circuit boards are fibreglass and are pretinned for easy soldering. Readers should note, however, that some of the PCB holes will need to be enlarged to mount the coils and the tuning gang.

The chassis is of 24-gauge cadmium plated and passivated steel while the wrap-around top cover is black Marviplate. All mounting holes and panel cutouts are pre-punched, as are the two holes that admit the alignment tool during the alignment procedure. The cabinet is designed for rack mounting.

While we did not assemble the kit it appeared to be complete in every detail. All components are of good quality and there were no component substitutions in the kit we received. In some kits, though, low leakage RBLL electrolytic capacitors may be substituted for some of the tantalums, but this is perfectly in order. Photostat copies of the articles published to date were included with the kit.

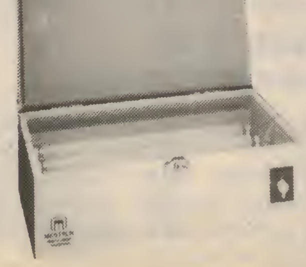
In summary, full marks to Jaycar for the effort involved in putting together this kit and, in particular, for the presentation of the metalwork and front panel.

Price of the Playmaster AM Tuner kit is $249 (plus p&p), while the alignment kit costs an extra $8. Further details from Jaycar Pty Ltd, 125 York St, Sydney 2000; or Cnr Carlingford and Pennant Hills Rd, Carlingford 2118. Telephone (02) 264 6688.

Royston UV exposure box

Royston Electronics now has available the Mentron UV exposure box, designed for use with photosensitive PCB materials such as Dupont Riston 3000 series and 3M Scotchcal materials. Designated model 300NSUV the unit is said to expose artwork down to approximately 0.55mm track separations. The exposure box is one of many products supplied by Royston to the electronics industry.

Dimensions are 230 x 390 x 680mm (H x D x W) and the unit includes an exposure timing switch, non-skid rubber feet and foam backed circuit board clamps.



Royston Electronics can also supply Royel desoldering tips, designed to operate with vacuum desoldering tools and claimed to provide significantly longer service life than conventional tips.

The longer service life is made possible by a plating technique which uses a nickel plating inside and iron plating on the outside of the tip.

Further information on the Mentron UV exposure box and Royel desoldering tips is available from Royston Electronics, 27 Normanby Rd, Notting Hill, Vic 3168 or 15/59 Moxon Rd, Punchbowl, NSW, 2196.

US defence contract to Aust. company

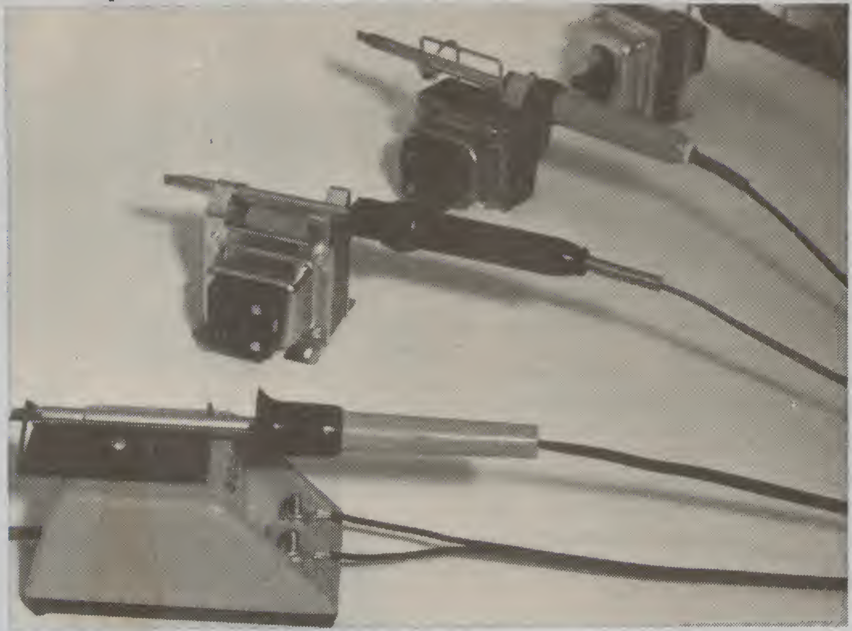
An Australian company, Morris Productions Pty Ltd, has won a $240,000 order for the supply of multi-layer printed circuit boards for use in the US Navy standard shipboard computer, as also used extensively in RAN ships. The contract, awarded by Sperry Univac Defense System Division, is one of the largest "offset" PCB orders received by an Australian electronics firm.

During the next 12 months Morris will manufacture and supply some 12,600 multi-layer printed circuit boards as part of Sperry Univac's Australian Industrial Participation (AIP) program. The Sperry Univac computers are installed in Royal Australian Navy destroyers and frigates as well as RAAF Orion P3C patrol aircraft.

The American company placed an initial test order with Morris early last year for 4000 multi-layer PCBs and rated the final product so highly that a big follow-up production order was placed last September. Morris is the first Australian company to manufacture multi-layer PCBs to US military specifications.

Apart from its defence capability, Morris Productions also provide a full printed circuit board service for Australian customers, particularly in the telecommunications and computer fields.

Scope Laboratories expands soldering range



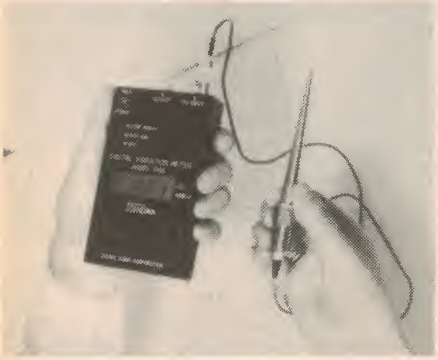
Scope Laboratories has released a redesigned version of their most widely used soldering iron, the Model SS "Superscope". Changes to the design include a more comfortable, impact-resistant temperature switch, and the handle is now orange and black. Apart from the new handle and switch housing mouldings, all parts are interchangeable with previous models.

The new Scope "Solder System" also includes a power supply with an electrostatic shield in a matching housing with a soldering iron rest. The Superscope's thumb switch allows control of tip temperature over the range 200° to 500°C and also modulates the effective wattage of the iron from 20W to 140W to suit the work required.

A 10W-70W "Miniscope" is also offered using the same power supply and a 12V version of the "Superscope" is also available.

For further information contact Scope Laboratories, 3 Walton Street, Airport West, 3042. Phone (03) 338 1566.

Vibration meter from Tecnico Electronics



Tecnico Electronics has been appointed the Australian distributor for Showa Sokki Corporation handheld vibration meters and can supply the model 1330 digital vibration meter. Specifications of the meter include the ability to measure acceleration and displacement from 0-20G and 0-2mm peak to peak respectively over a bandwidth of 5Hz to 5kHz. Features include a measurement "hold" function and an output to drive a recorder or oscilloscope.

The model 1022 is an analog instrument which incorporates a frequency analysis filter covering the range from 10Hz to 1kHz. Acceleration can be measured to 3G, velocity to 10cm/second and displacement to 1000μm peak to peak. A recorder or oscilloscope output is standard.

Both instruments are supplied with a vibration pick-up, contact probe and fittings, battery and carrying case.

For further information contact Tecnico Electronics, PO Box 50, Lane Cove, 2055, (02) 427 3444 or PO Box 520, Clayton, Vic 3068, (03) 542 3333.

Elmeasco has Datel-Intersil parts

Recently released by Datel-Intersil and available from Elmeasco, the DAC-UP10B is a 10-bit digital-to-analog converter which includes internal data registers, a high speed output amplifier and an input reference amplifier.

Outputs of up to 10V are possible with a settling time to within 0.05% of five microseconds. Two enable inputs simplify connection to microprocessor circuits and the device incorporates a buffer and amplifier to provide a 5V reference output voltage.

Also available from Elmeasco is an application note describing uses of the 9010 Micro-troubleshooter "guided fault isolation" program. Application note BO163 shows how the Fluke 9000-series microprocessor probe can be used in conjunction with a fault isolation program to allow the probe to gather data, including a history of signal transitions, pulse counts and signature analysis details.

In addition to being of value to users of 9000-series equipment, Elmeasco suggests that the application note will serve as a useful background for those considering the purchase of microprocessor test equipment.

For further information contact Elmeasco Instruments Pty Ltd, PO Box 30, Concord, NSW, 2137, or Elmeasco offices in all mainland states.

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AC188	88
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8833	2 60
8836	1 20
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1489	50
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81LS96	1 60
81LS97	1 60
81LS98	1 60
8T26	1 50
8T28	1 30
8T96	1 50
8T97	1 50
8080	5 40
8085	4 20
8086	59 00
8088	21 00
8155	3 85
8156	
8185	29 00
8202	1 50
8203	49 00
8206	89 00
8212	1 50
8214	1 40
8216	1 30
8224	1 75
8226	1 32
8228	2 65
8231	199 00
8237	32 00
8238	5 60
8243	2 60
8251	3 50
8253	3 85
8255	2 70
8257	4 56
8259	3 55
8271	77 00
8272	22 00
8273	45 00
8274	30 00
8275	31 00
8276	19 00
8282	6 50
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8284	7 00
8286	5 80
8287	5 80
8288	18 00
8289	62 00
8291	29 00
8292	25 00
8293 10	26 50
8741	41 00
8748	26 00
8749	49 00
8755	26 00
2911	25 00
2912	17 00
2920	90 00
3205 8205	6 70
3242	16 00
3245	9 50
3628	26 00
8008	54 00
8031 3	29 50
8035	5 20
8039	5 40
FD1771	12 50
FD1791	25 00
FD1793	26 00
FD1795	26 00
FD1797	29 00
WD1691	13 50
WD2143	11 00
WD1931	19 50
WD1933	29 00
WD1983	9 80
WD1993	54 00
WD2123	24 00
WD8250	15 00
TR1602	5 90
TR1863	5 30
BR1941	9 00
74F SERIES	
74F00	46
74F02	42
74F04	46
74F08	45
74F10	43
74F11	41
74F20	42
74F32	54
74F64	44
74F74	52
74F86	65
74F109	95
74F138	1 10
74F139	95
74F151	95
74F153	86
74F157	85
74F158	70
74F175	1 45
74F181	2 85
74F182	1 42
74F189	3 70
74F190	3 00
74F191	2 20
74F194	70
74F241	2 10
74F243	2 20
74F244	2 20
74F251	1 10
74F253	82
74F257	80
74F258	1 10
74F350	1 80
74F352	1 15

74F353	1 10
74F373	2
74F374	
74F399	
74F521	2 70
74F533	2 60
74F534	70
MEMORY	
2102	90
2112	5 80
2114	1 50
2708	5 30
2716	3 60
2732	5 30
2764	9 80
4116	1 50
4164	6 50
6116	6 50
58725	6 00
5101	3 00
2532	6 00
OPTO	
4N25	60
4N26	55
4N28	45
4N32	55
4N33	72
4N35	54
MCT6	1 10
MCT2	59
FND357	86
FND500	86
FND507	90
FND800	2 65
TIL31A	1 95
TIL81	1 60
BPW50	1 60
COY89	50
MOC3020	1 60
MOC3021	1 95
LEDS	
3mm RED	10
3mm YELLOW	14
3mm GREEN	12
5mm RED	09
5mm GREEN	13
5mm YELLOW	13
RED RECT	20
GREEN RECT	20
YELLOW RECT	20
RED CHROME BEZEL	65
YELLOW CHROME BEZEL	65
GREEN CHROME BEZEL	65
VOLTAGE REGS	
7805UC	45
7805KC	1 15
7812UC	45
7812KC	1 15
7815UC	45
7815KC	1 20
7818UC	48
7818KC	1 20
7824UC	48
7824KC	1 30
7905UC	55
7905KC	1 20
7912UC	55
7912KC	1 20
7915UC	55
7915KC	1 30
7918UC	55
7924UC	1 30
78L05	29
78L12	29
78L15	29
79L05	90
79L12	50
79L15	50
LM309K	1 15
LM317T	79
LM317K	2 10
LM323K	5 50
LM337T	1 60
LM337K	5 00
LM338K	5 80
LM350T	3 30
LM350K	4 60
LM396K	14 00
78H05KC	4 90
78H12KC	6 50
78HGKC	6 60
78P05KC	9 00
79HGKC	12 00
78S40	1 65
MC1496L	84
SPECIAL FUNCTION	
LM4250	1 80
NE5534N	1 25
NE5534AN	1 50
MC3340	1 40
76477	3 60
76488	5 95
8038	5 25
OM350	6 50
XR2206	4 30
XR2207	3 40
XR2208	2 55
XR2209	2 80
XR2211	4 70
XR2216	2 00
XR2240	1 90
XR2242	1 80
XR2243	2 00
XR8038	3 50
ICC7660	3 80
95H90	4 80
11C90	9 50
LM7555	1 20
MC10116L	90
LF13741	54
LF13741H	1 00
DS75451	35
DS75452	35
DS75491	47
DS75492	47
7216A	32 00
7216B	32 00
ADC0800	12 00
ADC0808	12 00
DAC0800	2 60
DAC0808	1 50
SAK140	78
4000	20
4001	20
4002	20
4006	60

4007	20
4008	55
4009	60
4010	48
4011	20
4012	22
4013	35
4014	70
4015	52
4016	35
4017	60
4018	65
4019	35
4020	50
4021	72
4022	53
4023	20
4024	39
4025	24
4026	90
4027	35
4028	65
4029	75
4030	38
4031	2 50
4033	1 50
4034	2 50
4035	70
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4041	80
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4043	62
4044	38
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4047	65
4048	45
4049	29
4050	35
4051	65
4052	80
4053	68
4055	1 80
4060	70
4063	90
4066	30
4068	24
4069	21
4070	20
4071	20
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4075	20
4076	75
4077	23
4078	24
4081	20
4082	20
4085	96
4086	36
4089	1 70
4093	36
4094	60
4099	98
4104	1 80
4160	65
4161	80
4163	85
4174	60
4175	60
4194	60
4409	4 30
4410	7 80
4411	8 40
4415	4 80
4419	2 70
MC14433	8 50
4435	3 89
4443	2 28
4458	5 70
4469	11 50
4490	3 60
4495	1 50
4500	4 00
4501	25
4502	67
4503	47
4504	76
4507	26
4508	95
4510	65
4511	65
4512	56
4513	1 14
4514	1 55
4515	1 80
4516	66
4518	66
4519	55
4520	70
4521	1 48
4522	87
4526	71
4527	71
4528	68
4529	92
4530	80
4531	78
4532	95
4534	4 50
4536	3 20
4538	76
4539	48
4541	70
4543	66
4544	1 90
4549	3 20
4551	1 25
4553	2 30
4554	1 20
4555	45
4556	52
4558	95
4560	1 88
4562	3 45
4566	1 20
4568	2 00
4569	1 30
4572	42
4580	4 20
4581	2 10
4582	75
4583	85
4584	46
4585	66
4597	2 20
4599	3 00
45104	4 80
45106	5 86
45107	4 65
DIODES	
1N4148	03
1N4001	04
1N4002	04

1N4004	05
1N4007	07
1N5408	15
74C SERIES	
74C00	25
74C02	30
74C04	25
74C08	30
74C10	32
74C14	36
74C20	43
74C30	40
74C32	31
74C42	98
74C48	1 50
74C73	56
74C74	50
74C76	73
74C83	1 70
74C85	1 10
74C86	25
74C89	3 36
74C90	1 14
74C93	1 15
74C95	1 25
74C107	90
74C150	2 90
74C151	2 10
74C154	3 36
74C157	2 20
74C160	1 05
74C161	95
74C162	1 10
74C163	1 10
74C164	1 55
74C165	1 45
74C173	76
74C174	72
74C175	83
74C192	1 40
74C193	86
74C195	1 42
74C200	9 50
74C221	1 40
74C240	2 10
74C244	1 60
74C373	2 25
74C374	2 20
74C901	56
74C902	56
74C903	68
74C904	65
74C905	9 00
74C906	47
74C907	47
74C908	1 20
74C910	10 00
74C911	9 00
74C912	9 00
74C914	1 85
74C915	1 55
74C917	9 00
74C918	1 50
74C920	4 50
74C921	4 50
74C922	4 80
74C923	4 50
74C925	6 00
74C926	5 60
74C927	5 00
74C928	6 00
74C929	3 50
74C930	3 50
74C932	1 20
74C941	1 90
74C989	7 00
74LS SERIES	
74LS00	18
74LS01	24
74LS02	18
74LS03	18
74LS04	20
74LS05	22
74LS08	18
74LS09	21
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74LS11	20
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74LS32	18
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74LS38	22
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74LS49	72
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74LS122	46
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74LS158	34
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74LS161	42
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74LS247	60
74LS248	40
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74LS377	65
74LS378	45
74LS386	35
74LS390	58
74LS393	50
74LS447	45
74LS629	2 20
74LS640	1 35
74LS670	90
CPU	
6502	7 90
6502A	8 50
6507	7 50
6520	2 50
6522	7 00
6522A	9 00
6532	9 00
6545	16 50
6551	12 00
6800	3 70
6802	4 80
6808	3 30
6809	11 00
6810	2 50
6820	2 30
6821	2 20
6840	4 00
6845	9 00
6847	5 40
6850	1 95
6875	8 20
Z80CPU	4 20
Z80ACPU	4 50
Z80BCPU	12 00
Z80P10	3 78
Z80AP10	4 30
Z80CTC	4 00
Z80ACTC	4 30
Z80DMA	13 00
Z80ADMA	15 00
Z80AS10	15 00
Z80S10	13 00
AY 3 8910	7 50
MM5303	4 50
LH0002	7 00
LH0042CH	6 00
LH0070	12 00
LH0071	12 00
TL061	70
TL062	1 30
TL072	1 10
TL074	1 80
TL081	40
TL082	90
TL084	1 50
TA7205P	1 20
UAA170	3 75
UAA180	3 75
LM10CH	5 00
LM301	30
LM301H	85
LM305H	70
LM307CN	45
LM307H	90
LM308	45
LM308H	55
LM309K	1 20
LM310N	2 10
LM310H	2 50
LM311	35
LM311H	77
LM317T	79
LM317K	2 10
LM318	1 45
LM319	1 50
LM324	45
LM325	2 80
LM329DZ	60
LM335Z	1 35
LM339	47
LM348	95
LM349	1 30
LM350K	5 50
LF351N	36
LF356N	95
LF357	86
LM358	50
LM377	2 20
LM378	2 70
LM379S	3 40
LM380 8 pin	86

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LM380	14 pin	.77
LM381		2.00
LM382		1.50
LM383		2.50
LM384		2.00
LM386		.56
LM387		1.10
LM390		1.95
LM393		43
LM394		2.95
LM396K		14.00
LF398		3.50
NE555		.27
NE556		.58
NE558		1.50
NE565		.93
NE566		1.44
NE567		96
NE571		1 75
LM709 14		40
UA710CN		46
LM711		46
LM723		43
LM723CH		67
LM725		54
LM733		62
UA739		78
741		26
UA747		.54
UA748		.39
MC1350		1 25
MC1445		2 95
MC1456		1.20
MC1458		.35
MC1466L		10.00
MC1488		.50
MC1489		.50
MC1494		6.00
MC1495		5.50
MC1496		.85
LM1596		1.70
LM1830		2.50
LM2917	8 pin	2.00
LM2917	14 pin	2.00
MN3001		14.00
CA3028		1.55
CA3059		3.00
CA3080		.82

CA3086	.40
CA3089	2.10
CA3130E	1.10
CA3130T	1.20
CA3140E	.56
CA3140T	.90
LM3401	.70
LM3900	.60
LM3905	1.10
LM3909	1.00
LM3911	1.85
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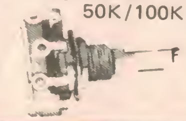

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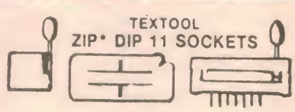

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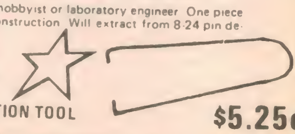

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Industrial quality. Narrow profile enables work in densely packed areas. Tool includes a remarkable pin straightener built into the handle.

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Shortwave Scene

by Arthur Cushen, MBE

Decision awaited on New Zealand's SW service

When the New Zealand Government withdrew its $180,000 subsidy to Radio New Zealand's shortwave service the Broadcasting Corporation of New Zealand undertook to fund the service until March, 1983, when a decision on the future of the service will be made by the Communications Advisory Council.

The Advisory Council is looking not only at the future of shortwave from New Zealand, but also the use of cable television and domestic satellite reception. The Shortwave Service is being funded at present by the Broadcasting Corporation of New Zealand, the body controlling the state operated radio and television services. It receives its income from radio and television licences and from commercial advertising on radio and television. The Broadcasting Corporation of New Zealand is continuing to operate two 7.5kW transmitters up to March, 1983; a service which was previously funded by the Government's Foreign Affairs Department.

The change resulted in cancellation of the special services which were part of the Radio New Zealand shortwave program including some Pacific Island language broadcasts, and New Zealand Calling. The latter featured a mailbag session and my own DX program which was broadcast for 22 years. There are many listeners in the South Pacific, New Zealanders living in Australia, and Australians, who have missed the specialised programming from Wellington, but the Broadcasting Corporation of New Zealand have every confidence that the Service will continue and have recently issued a tentative schedule for the period commencing on May 1.

This includes two new frequencies, 9620 and 9655kHz, and the proposed schedule from May 1 is as follows: 1800-2100UTC 9655kHz; 1800-2100, 11960; 2115-0815, 17705; 2115-1215, 15485; 0830-1215, 9620kHz.

Radio New Zealand commenced operating on shortwave on 26 September, 1948 and has continued to broadcast for 18 hours a day since then.

PEKING CHANGES NAME

Radio Peking recently became known as Radio Beijing following the adoption, in 1979, of the romanisation of the Chinese alphabet. Radio Peking advised that they did not change the name until January 1, to allow listeners to be more familiar with the romanisation of Chinese names and places. It was in 1979 that the Chinese State Council decided to use the Chinese phonetic alphabet to romanise Chinese names and places. The station feels that sufficient time has elapsed for listeners to be aware of the name change, and now all broadcasts come under the name of Radio Beijing.

Many transmissions from Radio Beijing have appeared near 8500kHz. The English broadcast to Australia and New Zealand at 0830-0930, and repeated at 0930-1030UTC, is now scheduled for 8425, 9860, 11600, 15195 and 15435kHz. Other frequencies being used are 8300kHz, 100-1100 in Hakka; 8345, 1130-1200 in Vietnamese; 8490, 1130-1200 in Thai; 8260, 1300-1330 in Esperanto; 8240, 1500-1600 in Hindi; 8660, 2200-2300 in Spanish; 8450, 2230-2300 in Standard Chinese. (From the BBC Monitoring Service.)

OUT OF BAND CHANNELS

BELGIUM: Brussels is using 6225kHz with an English broadcast at 1915-2000UTC. This new frequency has also been observed in other transmissions to Europe, and it is obvious that the congestion in the 49 metre band has forced the station to move outside the authorised frequency range.

SPAIN: Madrid, with broadcasts in Spanish, operates on 15535kHz from 1900-2300UTC week days. The broadcast on Sunday is 1930-2245UTC.

PAKISTAN: Radio Pakistan is using the out-of-band frequency of 9460kHz for its World Service. This frequency replaces 15545kHz, while 11670 carries the same transmission. The English broadcast is 1645-1745 with news at 1700UTC. The Turkish broadcast has also been noted on 17641kHz, replacing 17620kHz, at 1630-1730, and also on 13605kHz. (BBC Monitoring Service.)

BRAZILIAN SIGNALS

Reception from Brazil on the higher frequency bands has been most encouraging during the present summer daylight period, and listeners in Australia and New Zealand report many stations.

During the afternoons Radio Guaiba has been noted on 11785kHz after Deutsche Welle leaves the frequency at 0330, until Radio Guaiba closes at 0405UTC. Radio Inconfidencia on 15190kHz has been heard at 0203 with full station identification and a pleasant music program, according to Bryan Clark in the New Zealand DX Times. Another signal on 15415kHz originates from Radio Clube; Ribeiro Preto heard at 0052UTC.

Radio Bras continues to be heard on several frequencies. The service to the Amazon on 11780kHz in Portuguese is at 0800UTC.

Notes from readers should be sent to Arthur Cushen, 212 Earn Street, Invercargill NZ. All times are UTC (GMT). Add eight hours for WAST, 10 hours for EAST and 12 hours for NZT. In areas observing daylight time, add a further hour.

REVIEWS OF RECENT

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PERCY GRAINGER PIANO RECITAL ...

GRAINGER — Piano recital of some of his own works recorded from improved Duo-Art pianola rolls made in past years. Philips Analog Disc 6514 294.

Credit for the compilation of this record goes to Denis Condon of Sydney and two friends, Peter Phillips and Harold Ball.

During the first quarter of this century, a considerable amount of music was recorded for the pianola — a reproducing piano using perforated paper rolls and a mechanism powered by bellows operated by the player's feet. The instruments varied widely in quality but all had little levers arranged in front of the keyboard, ostensibly to allow the operator to vary tone, dynamics and other aspects of expression. The result, however, still tended to sound mechanical.

However, the Duo-Art Company managed to develop instruments and matching rolls which could reproduce quite closely a piece as played by the composer, or other enlightened musician. Many of the Duo-Art rolls were amazingly lifelike.

Nevertheless, production of Duo-Art instruments and rolls ceased in the early '30s when the home music market swung over completely to the (by then) much improved gramophone and, of course, to "wireless". However, interested in the musical history they represented, Mr Condon set about collecting Duo-Art rolls and now owns thousands of them. Existence of the collection, in turn, encouraged him to set about improving the original reducing system.

In the record sleeve notes Mr Condon writes: "Four areas of improvement presented themselves":

1. Elimination of the pianola controls mentioned above, thus simplifying the mechanism.

2. Using more efficient pneumatic devices not available to the designer of the Duo-Art 70 years ago, because they were patented by competitors.

3. Making use of today's technology (a marriage in this case of pneumatics and electronics).

4. Building a machine called a Vorsetzer (German "setter before") a device having felt fingers and feet which can be set before any piano so that Duo-Art rolls from the past can be greatly enhanced by playing on a quality instrument.

(A complete article on the Vorsetzer appeared in our October '78 issue. Ed.)

Mr Condon continues: "We like to think that you are hearing on this record the best possible sound from Duo-Art rolls."

We are. And, as I mentioned above, the improvement in the reproduction of the nuancing as Grainger played the piece, will astonish you.

Grainger was a musician whose true greatness has never been completely recognised in his own country (Australia). Most of his work, either in performance or composition has a fresh, open air sound about it. He was a jolly fellow given to leaping into the air for sheer joy in the movement. He scorned the usual foreign language musical instructions — allegro and so on — and substituted his own in English — play louder, not so fast and others.

He was friendly if sometimes boisterous chap with friends all over the world, including Australia, which nevertheless disgracefully neglected him. He gathered folk songs enthusiastically, some of which are included in the recital under review. His touch could be tough or sensitive and he scored admirably for orchestra.

In the 18 pieces featured here, there are among them a few for one piano, four hands, in which he is brilliantly partnered by Lotta Hough. All the pieces are brief and all reveal his great vitality. As does his playing. (J.R.)

FRANK, WOLF — Juilliard String Quartet

FRANCK — Quintet in F Minor
WOLF — Italian Serenade. Juilliard String Quartet joined in the Quintet by Jorge Bolet (piano). CBS 74002.

There was a time when the Juilliard was noted for its performances and recordings of contemporary music. Indeed they tended to favour this type of music rather than the classics. It is ironic nowadays to hear them in a work composed by a musician in the latter half of the 19th century. Nowadays, the mere mention of Franck's name on a program devised by the avant garde would cause bitter comment!

But there is one side of the story in which the composers of real music can rejoice: after about 80 years of plugging, the atonalists, at most of their concerts or operas, can attract only the most minuscule of audiences. It is a good example of the adage "You can fool some of the public some of the time . . . etc."

Despite avant garde opinion, Franck wrote music, some of which will still be played when the avant garde have been long forgotten. To quote a few: the Violin Sonata, Symphonic Variations and D Minor Symphony. There is a touch of treacle in the first and last of these but the Variations is a superb example of its type. I can always enjoy a good performance of this little masterpiece.

Again, ironically, the original performers of the Quintet under review, which was first performed in 1880, were

Reviews in this section are by Julian Russell (J.R.), Neville Williams (W.N.W.), Leo Simpson (L.D.S.), Norman Marks (N.J.M.), Greg Swain (G.S.), and Danny Hooper (D.H.).

renowned for their daring expeditions into "modernisms" and I find it hard to believe that Saint-Saens and even Liszt dismissed the work as rubbish. Later it won great popularity among those who had previously reviled it. Composers as different as Liszt and Saint-Saens based their complaints on the trivial fact that the Quintet was too emotional to conform to the rules of chamber music.

He was Belgian born, a fact that shows up in many aspects of his music, which is by no means French. Wagner figured largely as an influence. But despite Franck's occasional lushness, his music is always cleanly expressed and logically put together.

The Juilliard attack the work alternately with zest and quiet eloquence. It cannot be described as great, even when the Juilliard play it, and if it doesn't always grab the interest, it never outrages the ear. Its only fault is in the recording of the piano part which is usually too far forward for perfect balance with the other instruments. What's more Jorge Bolet tends to thump when he plays loudly.

The analog sound is first rate, except for overemphasis of the piano part, and the dynamic range is adequate and undisturbing. (J.R.)

LIEDER: Mahler, Wagner

MAHLER — Ruckert Lieder.
WAGNER — Wesendonck Lieder. Yvonne Minton (mezzo-soprano) with the London Symphony Orchestra conducted by Pierre Boulez. CBS Analog Disc 74092.

To my ear, the engineering of this analog disc does less than justice to Yvonne Minton's lovely voice. Everything she does is right. Her production is faultless, her phrasing seldom departs from the traditional, and she always lets the listener know what she is singing about.

Yet, compared to the sounds she produces in a concert hall or opera house, it loses some of its bloom here. I cannot put my finger on just what is wrong: perhaps it was recorded on one of her off days. In other words I found the recital slightly disappointing.

Video cassette review

DIE FLEDERMAUS

DIE FLEDERMAUS, composed by Johann Strauss and featuring Joan Sutherland, Robert Gard, Monique Brynnel, Anson Austin and other principal artists of the Australian Opera. With the Elizabethan Sydney Orchestra, conducted by Richard Bonynge. Colour, 1982, running time 155 minutes. On VHS with compatible stereo sound, and on Beta. Distributed by Syme Home Video.

Many readers of this magazine may have seen this particular performance from the Sydney Opera House, when it simulcast live over ABC television and FM radio on July 10, 1982. If you're one who did, you may welcome the opportunity to see it again (and again) with the added advantage that, with a cassette, you can readily skip through those parts that could become tedious with repeated viewing, and concentrate on what pleases you most.

If you chose not to watch it on TV/FM, the cassette could provide you with the opportunity to make acquaintance with this particular art form in a most agreeable fashion. Listen to the overture and I'd be surprised if you didn't register instant recognition of its many melodic themes.

The story . . .

The synopsis and cast notes which occupy the screen during part of the overture might put you off a little by making the plot seem rather complicated. In fact, once the curtain rises, and despite the difficulty of following the lyrics in detail, there's never any doubt about who's who, and who is doing what to whom and for what reason!

After all, it is described as an operetta and it is, in many ways, an extension of the popular level operettas and musicals that are presented in live theatres around the nation.

The story of Die Fledermaus is the outworking of a practical joke, played sometime previously by Gabriel Von Eisenstein (Robert Gard) on Doctor Falke (Michael Lewis). Both had gone to a fancy dress party where Doctor Falke in particular had imbibed too freely. Gabriel had abandoned him, drunk, in a city park, leaving him to make his way home next morning still dressed as Die Fledermaus — The Bat. Weary of being called "Die Fledermaus", Dr Falke had determined to even the score — which is what the operetta is all about.

His task is made easier by the obvious fondness of Gabriel for the fair sex, by the boredom of his wife Rosalinde (Joan

Sutherland), by her flirtatious maid Adele (Monique Brynnel), and by a variety of other characters who are the stuff of which operettas are made.

In this case they have turned it into a fun occasion with Joan Sutherland mixing some fine singing with her share of the one-liners. In fact, the singing is excellent overall, with Monique Brynnel's laughing song so well done that the mirth is infectious — almost too infectious!

Direction and choreography is of a very high standard, as also is a ballet sequence in Act 11.

By the time Act III draws to a close, Dr Falke has made his point and, in the manner of most operettas, everyone that matters seems set to live happily ever after!

In terms of technical quality, the cassette isn't too promising at the beginning, with the TV cameras starved for light before the curtain rises, producing, a mix of video noise in the shadows and flare from pin-point highlights. But, once the curtain rises and the cameras can rove freely across the brightly lit stage, the picture quality comes well up to normal cassette standards.

My VHS copy had a stereo track but I did not have a stereo playback unit available to take advantage of it. However, while the cassette track — in stereo or mono — would have been no match for the original live stereo broadcast, it too was well up to normal expectations and gave no real cause for concern except in one isolated spot part way through Act II, where the pitch sagged right in the middle of a final crescendo.

Die Fledermaus can provide a most enjoyable evening of video entertainment and I would recommend that you avail yourself of the opportunity. The recommended retail price is $99 but it's the sort of cassette that will stand repeat playings from time to time. One would hope that other operas which are in view for future release by the Syme organisation are equally successful. (W.N.W.)

Of one thing I am certain. I preferred her performance of the Wagner songs to the Ruckert group. It seems to me that when Mahler sings of love, its expression has more than a share of intellectuality. On the other hand Wagner's style is always erotic, always fleshy.

Mahler was always a serious fellow, Wagner was much more volatile. Mahler's scribing was a marvel of changing colour, Wagner is always sensuous, even in it slightest moments. Yet, even using her great art to the utmost perfection, Ms Minton fails to move me as I had hoped to be moved.

At a guess, the missing factor could be in Boulez' conducting. There is always impeccable accuracy but, where Mahler's expressions of love lean towards intellectuality, Wagner never leaves the physical side unstated. And what Frenchman would overlook that? The analog sound is fine.

The recital comprises the five Ruckert songs on one side and the Wesendonck Lieder on the other. Here I must add a note of warning. Those readers of this column who do not understand German will find difficulty in following the English translation of the texts that accompany the disc. The Ruckert has "At Midnight" coming last. It is, in fact, sung second. (J.R.)

GOSPEL PIANO ... Liberace style

ENCORE. Dino, piano with orchestra and chorus. Stereo, Light LS-5809. (From Word Records Aust, 18-26 Canterbury Rd, Heathmont, Vic 3135. Phone (03) 729 3777.

Normally identified only as Dino, this popular young pianist, specialises in entertaining Gospel-orientated audiences with elaborate improvisations around Gospel themes. And, to give him his due, he's very good at it, indeed.

However, and particularly with this latest release, it is difficult not to see him edging towards the Liberace mould, with grand piano, white suit and audience come-on, spotlighted against a red backdrop. And, as he plays against a sonic backdrop of orchestra and chorus, you're suddenly aware that what started out as "Amazing Grace" has suddenly and unaccountably become the "Spellbound" theme — and so on.

What's wrong with that?", you ask, and it's a perfectly understandable question. If you have a soft spot for the Liberace style, you'll probably enjoy every moment of this album because, as I said, Dino does it very well.

But, if you prefer your Gospel tunes,

rearranged perhaps but not mingled with classical and other snippets, you may prefer that he didn't try quite so hard to be different.

Be that as it may, the titles which form the basis of the music are: Amazing Grace — Just A Closer Walk — The Day That I Met Jesus — Little Davis Play On Your Harp — No Greater Love — The Love Of God — Showers Of Blessing — When They Ring Those Golden Bells — Ten Thousand Angels — The Lord's Prayer.

The sound quality is well up to standard and, if the style of this talented Christian entertainer appeals, you'll thoroughly enjoy it. It's over to you. (W.N.W.)

MERRILY WE ROLL ALONG. Music and lyrics by Stephen Sondheim. Produced for records by Thomas Z. Shepard. Original Broadway cast recording. RCA Red Seal stereo, half-speed mastered. CBL1-4197.

This recording comes in an elaborate double jacket carrying background notes on the show, details of the cast, about 18 colour pics giving some idea of the staging, and a complete libretto. Let it be said that, if you're a newcomer to the show, you'll need all of this plus a deal of application to get with it!

Even the background to the present musical makes complicated reading. In 1931, Moss Hart began work on a play that would trace the life of an American family from the opening of the century to the crash of 1929 — only to find that, in his "Cavalcade" produced in the same year, Noel Coward had anticipated the theme.

So Moss Hart re-wrote his play and reversed the time scale so that the climax came first, with each succeeding scene accounting for the one that had gone before. After several changes of name it opened in 1934 as "Merrily We Roll Along".

Almost 50 years later, another production and writing team took up the concept of the 1931 show, and centred it around the ideals and aspirations of

WIDOR ORGAN SYMPHONY: impressive

WIDOR: Symphony No. 5 played by Jane Parker-Smith at the organ of Salisbury Cathedral. Quadraphonic, World Record Club R-09443.

In a stack of records, this album would hardly rate a second glance. Printed in black and brown, with a course screen, the cover depicts a turn-of-the-century gentleman, who might be anybody or nobody, playing a 5-manual organ in a turn-of-the-century manner. The picture sits oddly against the name Jane Parker-Smith.

But put the disc on the turntable and it's a very different picture. As Jane Parker-Smith plays the first four movements on side one, it becomes evident that hers is no routine performance; one begins to think of adjectives like alert, aware, vital . . .

But on side two comes the fifth movement — the much-performed Toccata (Allegro) — and one has to add "positively robust", without casting any reflection on the musicality of the performance. It stands immediate comparison with another notable performance of the movement by Germani, also on a W.R.C. release.

On the same side, Jane Parker-Smith continues with "Toccata in F major" (Grison) and "Sonata Eroica, Op 34" (Jongen). In this latter work the dynamics range from tiny pipes in some obscure remoteness of the Cathedral to the massive full organ, which is at odds with the knowledge that it's all being initiated by one lone woman, still in her twenties!

(If this sounds like a chauvinist remark, it isn't meant to be. I have in mind the sheer physical effort involved.)

According to the jacket notes, Jane Parker-Smith was born in 1950, studied organ, piano and harpsichord at the Royal College of Music, made her London debut at Westminster Cathedral in 1970, was featured and recorded by the BBC, won a French Government scholarship and replaced Ferdinand Germani, at short notice, for a Royal Festival Hall performance in 1975.

The organ at Salisbury Cathedral is a 4-manual Father Willis instrument, installed in 1876-7, rebuilt in 1934 and overhauled again in 1968. A magnificent instrument, it has been magnificently recorded here by EMI for the World Record Club.

If you're a classical organ fan and are not already overstocked with this particular Widor symphony, I think you'll especially enjoy this one. (W.N.W.)

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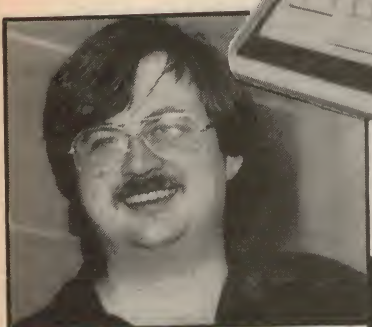

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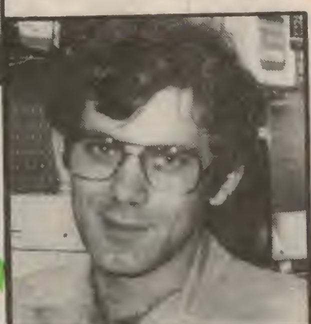

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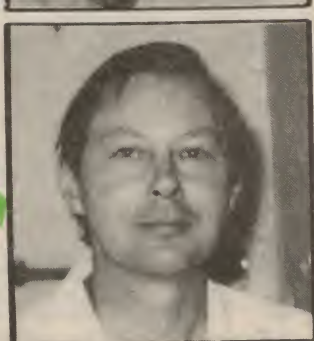

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DICK SMITH ELECTRONICS

See page 98 for full address details

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RECORDS & TAPES — continued

American young people in the time slot 1980-1955 — a period during which the nation had grown to be socially fragmented and "me-centred". It opened in November 1981 under the same name.

It's a musical but, as judged from the album, not one of the traditional kind, with a sequence of individual numbers including (hopefully) a sprinkling of hits and show stoppers which soon get to stand alone. The lyrics are a rapid-fire verbal exchange which are hard enough to follow from the libretto, let alone to have sung in the first place.

To come to grips with the show, from the album only, it would be necessary to follow it through a scene at a time, reading the summary first, looking at the stage pics, and then reading and listening to the corresponding lyrics. In fact, in a jacket note, composer Stephen Sondheim suggests the possibility of working through the show in reverse order.

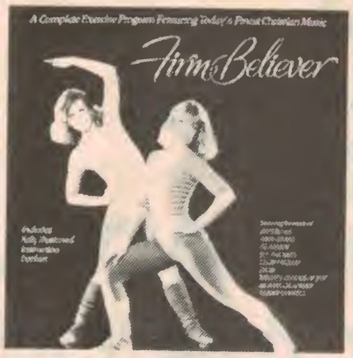
Need I say that I didn't have that kind of time to spare so I remain somewhat confused about it all.

But at least I've drawn the new musical to your attention and, if you want to absorb a show that is youth centred — albeit American youth centred — then there's all the material you need within this new RCA package.

Technically, it has the atmosphere of a stage recording but the quality is quite satisfactory. (W.N.W.)

☆ ☆ ☆

FIRM BELIEVER — A complete exercise program featuring today's finest christian music. With instruction booklet. Stereo, Dayspring DST-4105. [From Word Australia, 18-26 Canterbury Rd, Heathmont, Vic 3135. Phone (03) 729 3777]



Recently, I had occasion to review a video cassette featuring exercises, yoga style. It was very gentle, very relaxing, probably just the thing for tense, careworn adults!

This sound album is all the other way. Judy Moser and Bobbie Wolgemuth are two attractive lasses, who have a strong conviction that a healthy Christian life has something to do with a healthy body and they're determined to get you fit — even if it kills you!

Perhaps it's significant that the cover shots all show groups of young people doing their thing, presumably to the instructions recorded on this album and to the tempo of "today's finest Christian music": "Living Water" (Denny Correll); "Jesus Is The Rock" (The Mighty Clouds of Joy); "Hallelujah" and "His Name Is Jesus" (Al Green); "Stand by the Power" and "I'm Forgiven" (The Imperials); "Saved" (Loe Patillo); "The Unclouded Day" (B. J. Thomas); "Longtime Friends" (Morris Chapman); "Hearts Made of Stone" (Dion); "El Shaddai" (Amy Grant).

For those who are still keen, personally, or on behalf of a church P.T. group, Judy's and Bobbies' exercises, explained in the booklet and called on the disc include: warm up stretch, aerobics, arms, waist standing, waist sitting, abdominals, legs, hips, buttocks, and cool down.

The very thought of it makes me tired — but then it's something that you young people ought to do! (W.N.W.)

☆ ☆ ☆

THE CLEAN TAPES. The very best of Peter Cook & Dudley Moore. Stereo, HIFLY-26. Released through the World Record Club R-90428.

I doubt that I've ever seen a record with as many source credits: BBC Records; Cube Records 1965, 1966, 1968, 1969, 1971; Essex; EMI Australia; World Record Club!

One would infer from the title that, somewhere, there are some not-so-clean tapes. Presumably, they would be characterised by more than the occasional epithet that punctuates this one.

Dating from 1965, the album resurrects the crazy humour that was so much a part of BBC radio in that era: crazy situations, as depicted by the Goons and crazy, high-speed patter, as here. Some of it is spontaneously funny, some of it relies on characters created during the series, and some of it relates to the social scene of the period.

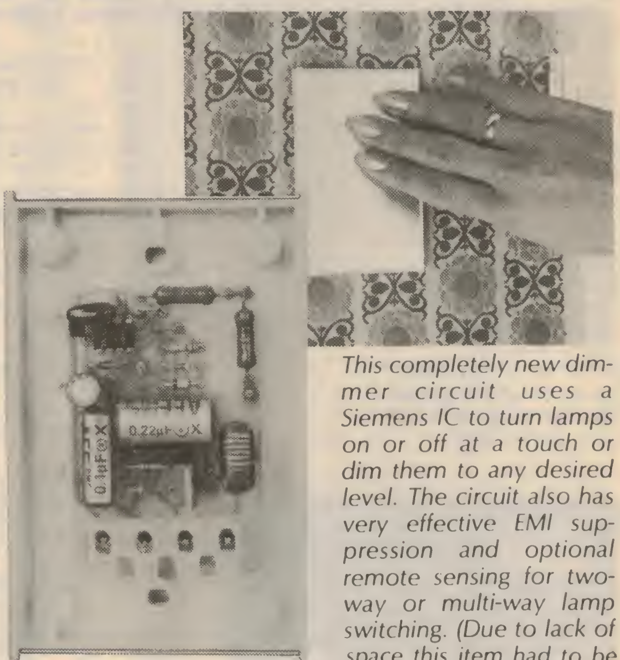
If you lived through it, you'll know what I mean. If you didn't, you'll sit through one or two of the tracks, wondering what the audience found so funny.

Anyway, here are the track titles: The Newsreel Overture — The Music Teacher — Tramponuns — Lovely Lady of the Roses — Dud and Pete on Sex — Isn't She a Sweetie — The Real Stuff — Aversion Therapy — Father and Son — Lengths — Goodbye.

Mainly dialogue, with two or three tracks of sent-up "music", the quality is quite okay. If you're a Cook/Moore fan from way back, this album will bring you over 50 minutes of the nonsense that made them famous. (W.N.W.)

Coming Next Month*

Touch-lamp dimmer



This completely new dimmer circuit uses a Siemens IC to turn lamps on or off at a touch or dim them to any desired level. The circuit also has very effective EMI suppression and optional remote sensing for two-way or multi-way lamp switching. (Due to lack of space this item had to be held over from March.)

Simple stereo simulator

Our stereo simulator is a simple and economical way of providing a simulated stereo signal from a monophonic source. It can be used with virtually any mono signal source including the EA Playmaster AM tuner.

8-channel audio mixer

This eight channel stereo mixer with balanced inputs is equally at home on stage, in the studio or in a disco. Features include bass, mid-range and treble equalisation on all inputs, audio effects capabilities and clean, uncluttered layout. Details in April "Electronics Australia".

PLUS . . .

BONUS 156 PAGE CATALOG FROM DICK SMITH ELECTRONICS

* Our planning for this issue is well advanced but circumstances may change the final content. However, we will make every attempt to include the articles mentioned here.

WALL CHART

These two pages are invaluable for the Kit Builder and School Master. Printed circuit pricing and month of magazine coming out are included as well as name of kit and project. It not only helps us at Rod Irving Electronics to find the month and number of a kit, but also shows the incredible range we have available. Others say they are No. 1 for kits but we get on with the job, the range below proves it. Please note some of the older projects are in limited supply and might take longer to deliver. The challenge of building a kit as well as the knowledge gained from it, is invaluable, I would say that practical practice in electronics is the true key to successful understanding:-
May we all strive a bit harder for 1983 to make Australia a better country.

Rod Irving

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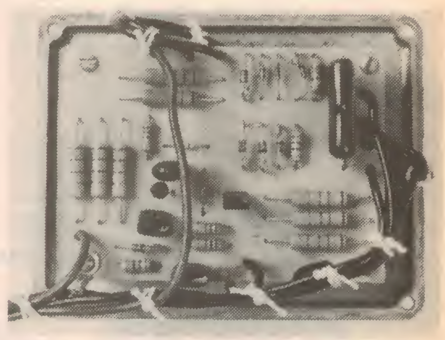

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The AED Universe Supercomputer II

Sydney-based firm Acoustic Electronic Developments has produced an advanced small business computer system which can rival and perhaps surpass anything that overseas manufacturers have to offer.

by PETER VERNON

The AED Universe Supercomputer II is based on the S-100 bus with selected imported and locally-built components. Dual processors allow the system to run standard CP/M 2.2 software in addition to the 16-bit MS-DOS and CP/M-86 operating systems, to be available shortly.

Features of the system include an enhanced CP/M operating system which allows the user to switch between any one of a number of different printers at any time and to define a menu of up to 10 programs which can be swapped in and out of memory and run while current work is automatically saved and restored as required.

Physically the AED Supercomputer is a departure from the desk-top systems normally featured in these pages. The computer itself is enclosed in a free-standing cabinet sized to fit under a three-drawer office desk. Dimensions of the cabinet are 64 x 46 x 64cm (W x H x D), and it is fabricated from white enamelled steel with a black front panel containing the on/off key switch, illuminated reset button and AED logo in addition to three 20cm disk drives.

Both the 30cm video monitor and the separate keyboard are enclosed in impact-resistant plastic cabinets in a brown and buff colour scheme and are connected to the computer cabinet by a 1.5m ribbon cable. An automatically switched 240VAC outlet on the rear of the computer cabinet provides power for the terminal.

Disk operations are performed by a dedicated Z80 microprocessor with its own 32K disk buffer RAM and the keyboard and video display terminal are also controlled by separate microprocessors. When combined with AED's custom software the result is a fast and extremely powerful computer system.

The Supercomputer II is based on a 20-slot shielded and actively terminated S-100 motherboard of AED's own design, complying fully with the IEEE 696 S-100 bus standard. A 20-slot motherboard to the same specifications is standard, and since a standard system comes with five occupied slots, there is plenty of room for expansion.

The hardware

Computing power is provided by a dual processor board with an 8-bit 8085 processor running at 6MHz and a 16-bit 8MHz 8088. Switching between processors is automatic and is performed by the system on the basis of the type of software loaded from disk. Standard CP/M programs run on the 8085, with 16-bit operating sytems and programs automatically switching in the 8088. In addition while the 8085 is running the 8088 is used to manage disk input and output.

A free-standing cabinet houses the circuitry and disk drives of the AED Supercomputer.

The system reviewed here is a single-user computer supplied with 64K of RAM provided by the Memoraed RAM board, a local product. This board also complies with the IEEE 696 bus standard and may be used in either 8-bit or 16-bit systems at clock speeds of up to 8MHz. It is a fully static board using CMOS devices for low power operation and has a number of unique features.

A 24-bit extended addressing scheme allows the board to be positioned anywhere in a 16 megabyte address space. Each 64K board can be enabled or disabled in 2K blocks and in addition, blocks of memory can be specified as common to all 64K pages, allowing a convenient communication area for multi-tasking and multi-user systems.

A "phantom" feature is also provided allowing memory devices which would otherwise conflict with each other to overlay one another without problems. AED use this feature to provide a full 64K of RAM together with video memory and a 32K disk buffer in an 8-bit computer system.

The disk controller of the "Supercomputer" is the Disk Jockey Direct Memory Access controller by Morrow Designs, an S-100 board which can control up to eight 14cm or 20cm disk drives (with a maximum of four drives of each size). A 4MHz Z80 is used to control data transfers between the disk drives and the

AED's "Unserial terminal" combines a low-glare screen and a quality keyboard.

system memory without intervention by the main CPU. Because the disk controller is programmable virtually any disk format can be emulated.

At present software is provided to allow the controller to support soft-sectored IBM-compatible 20cm disk drives and North Star compatible hard-sectored 14cm drives. IBM Personal Computer and Tandy disk drive formats can also be provided by replacing two EPROMs on the disk controller board.

The chief advantage of the DJDMA disk controller is its Direct Memory Access channel. The disk controller takes over the address and data buses of the system by halting the processor and directs data transfers to and from the disk drives using the full addressing capabilities of the 24-bit extended address bus. The high speed disk transfers made possible by this system have allowed AED to offer software that goes far beyond standard CP/M in speed and convenience.

Universe Supercomputer II specifications

Processor:	8085 — 6MHz clock and 8088 — 8MHz clock.
RAM:	64K standard, with 32K disk buffer and 8K video RAM separately addressed. Maximum address space is 16 megabytes.
ROM:	CP/M bootstrap loader only.
Display:	80 x 24 lines, low-glare green phosphor, other formats programmable.
Keyboard:	103 keys, with separate numeric pad, word processing keys and user-definable keys. Typewriter style.
Disk storage:	Up to four 20cm disk drives, 1.2 megabytes per disk and four 14cm disk drives. 16 megabyte hard disk available as an option.
Documentation:	Comprehensive manuals for each component of the system.
Expansion:	Standard single user system occupies five slots of a 20 slot motherboard. Complies with IEEE 696 S-100 specification.
Software:	CP/M 2.2 with optional SUPERAED enhancements including selection between multiple programs without effecting work in progress and the ability to select any one of eight printers from the keyboard or from a program at any time. CP/M-86 and MS-DOS are offered with the 16-bit option.

The Supercomputer system reviewed here was provided with three 20cm disk drives, providing a total of 3.6 megabytes of storage. AED also offers a hard disk version of the computer with one 20cm floppy disk and a single 16 megabyte hard disk.

Communication with printers and other peripherals is handled by the "Saedio" board designed by AED. The board uses the Intel 8255 Programmable Peripheral Interface chip to provide three 8-bit bidirectional parallel ports, and fully complies with the IEEE S-100 bus standard.

Optionally available is the AED system support board providing a real-time clock/calendar, programmable timers and an interrupt controller for use in a multi-user system as well as additional serial I/O channels.

The "Unserial terminal"

The Supercomputer is provided with one terminal, a high speed memory mapped video display with its own microprocessor controller. The terminal is based on the SSM Microcomputer Products VB3A video board with refinements made by AED.

A maximum of 4096 bytes of memory can be directly mapped onto the screen of the terminal as alphanumeric characters or graphics, with programmable display formats of up to fifty 80-character lines. Read Only Memory on the board can be changed to provide other line lengths, such as 20, 32, 40, 64 or 96 or 132 characters.

In addition to the video RAM a second block of memory is provided to contain character attribute bytes which allow individual characters to be displayed as standard upper and lower case with attributes such as flashing, half-intensity, underline, inverse video or strike-through. Provision is also made for installation of a 2716 or 2532 EPROM to allow the user to select either the standard character set or 128 or 256 user-defined characters respectively.

The video monitor is a low glare, green phosphor type, with the controller programmed as standard for 80 characters by 24 lines. Characters are formed on a 9 x 13 matrix, making for a very readable display, with true lower case descenders. A dot graphics mode is also provided, allowing mixed text and graphics with a resolution of 160 x 96 pixels.

The keyboard provided with the terminal is a Honeywell Hall-effect type with its own internal microcomputer and eight byte First In First Out (FIFO) buffer to maintain a constant serial data transmission rate and provide a limited "type ahead" facility.

A total of 103 keys are provided, including 12 word-processing function

keys in a separate bank on the left and a 12-key numeric pad on the right. The top row of the keyboard consists of 14 user-definable keys, seven of which are used by AED's enhanced CP/M operating system in addition to two display speed control keys and a "Supershift" function key for further expansion of the keyboard codes.

The keyboard has a light, positive action, and is almost soundless in operation. Auto repeat is available for designated characters and there is also a separate repeat key for other printable characters. An audible output is available, although it was not fitted to the review machine.

Outstanding software

Hardware, no matter how sophisticated, is useless without appropriate programs and AED has gone to great lengths to ensure that the power of the computer system is fully utilised.

As previously mentioned, both 8- and 16-bit operating systems are available. CP/M V2.2 is supplied with the system, with enhancements by AED that maintain full compatibility with standard CP/M programs but provide a number of special features.

Enhancements include AED's "Superaed" version 5.0, developed to complement the hardware features of the Supercomputer. This program is completely compatible with standard CP/M, but provides additions such as selection of one of a number of printers, keyboard type ahead, clock/calendar routines and a powerful video display driver which can be customised to suit most terminals on the market.

Two keys are defined to provide control over the speed of the display screen to slow down listings for ease of reading or searches. A keyboard lock function allows the user to leave the computer unattended without worrying about unauthorised use, and a single programmable key allows screen output to be redirected to the current list device.

An additional program called "Smartkey" allows the keyboard to be redefined and another dedicated key enables either 7-bit or 8-bit output from the keyboard for use with special video driver routines. Keys can be defined to produce combinations of character strings to simplify entering often-used commands and the program also allows application programs to communicate with other programs via the keyboard so one program can call up another and pass data by simulating keyboard entries.

Superaed also allows the user to switch back and forth between an application program and a powerful 8080 system monitor simply by pressing two dedicated keys, a feature unique to the Supercomputer and invaluable to the assembly language programmer.

Parallel Program Access

A frequent problem with small computer systems is that they can only run one program at once. Once the user loads another program all details of the previous work are over-written. Because of this arrangement most computer users are unable to utilise the full potential of the system, using it only for the most critical current task while saving notes on paper for later "batch" processing of less critical applications.

Some business users attempt to overcome the problem with a custom written "integrated" suite of programs, combining the most frequently used programs in a menu-driven system. Apart from the expense the speed of program interchange in such systems is often inadequate, and very few of these systems allow programs to be swapped and restored without effecting current work. AED believe they have the answer to these problems.

Called "Multiple Program Selection" or MPS, this feature of Superaed allows the user to define a menu of up to 10 different programs and switch between them with just three keystrokes. The previous program, data and screen display is saved on disk and is fully restored on return.

AED gives an example of how this feature can be used as follows:

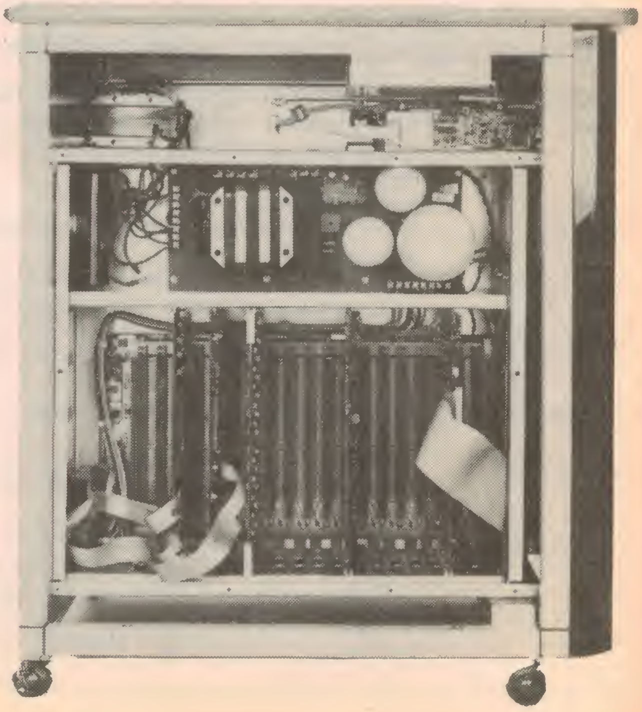
Suppose the business user is in the middle of composing a quotation with a word processing program and the telephone rings. If a client on the line asks for details of goods in stock, a touch of three keys puts the user in the enquiry level of the stock inventory program. If the client then decides to place an order, another selection from the MPS menu brings up the order entry program.

With the order filed the businessman can then place the client on a mailing list; the mailing list entry program is called up in the same way and the details entered. At the conclusion of the call three more keypresses return the user to the word processing program so he can take up exactly where he left off.

Any standard CP/M program can be run under MPS, interrupted and restored quickly and conveniently. The secret is the high speed of the AED computer system, which allows a complete copy of the current memory contents to be stored on disk in about six seconds. The third disk drive in the Supercomputer is dedicated to holding these "memory images", and in fact is not accessed by CP/M when the MPS option is running.

AED's "unserial terminal" is also required in order that the current contents of the video screen can be saved and later restored. While this terminal emulates a serial device, it is in fact much faster, in addition to providing the

Cont'd on p. 144



Accessibility is a feature of the AED design. Removal of a side panel reveals a 20-slot S-100 motherboard with five slots occupied and a large capacity power supply. The vacant S-100 slots are available for expansion.

Is Apple's new 'Lisa' set to take over?

Apple's new top of the line computer, Lisa, looks set to change the way people think about computers in the office. Over $200 million worth of research has been done to make Lisa easy to use for those who have no previous computer experience. So successful has this research program been that people who have mastered existing computer operating systems may be at a disadvantage when it comes to understanding Lisa.

Lisa has been designed to allow office workers to use the computer in a way consistent with normal office procedures without learning special control codes or computer languages. The display screen is organised as a desk top with documents and "folders" for file storage, a "trash can" for disposal of unwanted material and a series of command menus laid over the normal display.

The operator uses a small hand-held "mouse" which can be moved around on any flat surface to control the position of a pointer on the video display. A single button on the mouse allows selection of any of the menu options or activates a function symbolised by a small graphics image displayed at the side of the screen.

The video display is a 30cm, black on white bit-mapped screen capable of displaying 364 lines of 720 pixels each or up to 40 lines of up to 132 characters each. Although special function keys are normally replaced by pointer movements controlled by the mouse, the keyboard and numeric keypad can be programmed for special character fuctions.

Six integrated applications programs allow Lisa to fulfil the most common office tasks, word processing, financial planning, project management, business graphics and personal files on the screen simultaneously and transfer information instantaneously between any applications software.

The Apple Lisa comes with built-in floppy disk drives and a 5MB hard disk. The small device at the right is the "mouse" for controlling a pointer on the screen.

"Lisa embodies a radical change in how users work with computers", says David Strong, general manager of Apple Australia. "Conventional computers created obstacles for those who want to make their jobs more efficient. We used progress in microtechnology, plus advances in software integration, to remove many of those obstacles and to make a computer that really is simple to use."

Selection of applications programs and options within programs is made by pointing at and activating the symbol for a file folder, memo pad, wastebasket or other familiar office objects. Once selected an object is used just as its real counterpart. Folders, for example, can be opened to reveal the contents, and documents can be refiled, copied or thrown away. Disk operating system commands are a thing of the past.

Each of the basic functions of all six of Lisa's software applications programs operate in the same way. Once a user has learned one application the others can be learnt quickly and easily.

Users of Lisa computers can share peripherals and exchange information and files over "AppleNet", Apple's new local area network system to which all Apple computers can be connected. Apple also plans to offer interface devices for other local area network configurations, including Xerox Corporations' Ethernet. As with AppleNet, all types of Apple computers will be able to use the interface.

"LisaTerminal", a data communications package, is also available to allow the computer to function as a teletype terminal, a DEC VT 52 terminal or an IBM-compatible terminal.

Computing power is provided by the Motorola MC680000 microprocessor, which has a 32-bit internal architecture and 16-bit external data transfers. Three other microprocessors control input and output functions, including the mouse, disk I/O and the keyboard.

A standard system has a million bytes of main memory and 1.7 megabytes of disk storage on two built-in 14cm minifloppies. The disk drive, the Apple 871, is a proprietary Apple mechanism featuring high density double-sided operation, with a faster data transfer rate than conventional drives.

Also in the standard system is the five megabyte Apple ProFile hard disk drive, allowing Lisa's applications programs and data to be stored on one disk. Three expansion slots are available internally.

Also introduced with Lisa were two new printers, a high resolution dot matrix device and a letter quality daisywheel type.

Cost of the Lisa system with one megabyte of RAM, two Floppy disk drives and ProFile hard disk drive with applications software is $11,950 and stocks should be available shortly.

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MP-L2 Dual Parallel Interface
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Microcomputer News

Local Council spurns Australian manufacturer

Thousands of jobs are going begging in high technology industries in Australia because of the nation's "inferiority complex" according to marketing expert, John Holliday. Mr Holliday is General Manager of the Gold Coast firm Era Computer Corporation, but he and his company are getting little encouragement.

"You are really on your own in the high technology industry in Australia. The politicians don't want to know you, the bureaucrats just refuse to believe that home-grown products can match imports and a whole generation of Australians has grown up with no knowledge of the very high standards of high technology research and development within their own country".

Mr Holliday said that he had been "stunned" by a decision by the Gold Coast City Council on the award of a contract for a computerised administration and technical support system. Eracom had tendered for the contract, worth about $40,000, offering equipment built on the Gold Coast and able to meet every requirement of the tender.

"Eracom was one of only two tenderers to fit the tender requirements exactly".

"But we weren't even given a chance to make a presentation or demonstration to the Council and they gave the contract to an overseas company at a price a minimum of $8000 above ours". Since then the Council has stated that the quoted maintenance costs were the basis of the refusal of Eracom's offer, "but they have not even acknowledged that we were offering on the spot maintenance from our factory at Southport, ten minutes drive from the City Council Chambers".

In fact, said Mr Holliday, the council officers involved in the decision did not even bother to take the short drive to the Southport factory.

The same situation could not happen in other countries, says Mr Holliday. "The Americans, for example, have such rigid regulations to encourage buying at home that in a case like this with the Council, they would have to prove beyond any doubt that the local product could not do the job."

According to Mr Holliday, wherever authority – local council, state government and federal government – put some effort into fostering local high technology industries, there was enormous growth in job opportunities. "With more than half a million out of work in this lucky country, surely it is time that some level of authority made an effort to encourage local technology and manufacturing", he says.

Commodore donates VIC-20s for SA education

The Minister of Education, Mr Arnold, with a student from The Heights School, SA.

Students at The Heights School in Modbury, Adelaide, will be gaining practical experience in computing this year thanks to a donation by Commodore Australia. The donation, worth $13,000 includes thirteen VIC-20 microcomputers, to be used by students in years 5 to 8 at the school.

The computers will be used for educational activities including the teaching of typing skills, simple word processing and programming, and elementary computer assisted instruction. Twelve of the computers will be located at the school and the remaining unit installed at the SA Education Department's Angle Park Computing Centre.

Classroom installations will include two disk drives, a printer, cassette recorder, joysticks and a 16K memory expansion unit. A simple networking system will also be used to allow up to eight microcomputers to be connected to each disk unit and the printer.

80-column video board for the Super-80

A Sydney firm, MCE Microcomputer Engineering, has come up with an add-on board for the Super-80 computer which provides a video display of 80 characters by 25 lines, upper and lower case characters, inverse video and 128 user definable graphics.

The add-on 80-column board is based on the Motorola 6845 CRT Controller, a complete video display processor which manages memory and generates all the timing and video signals to drive a monochrome monitor.

Also on the enhancement board are 2K of video memory, 2K of memory for programmable graphics characters and a pre-defined character set in a 2K EPROM as well as the various buffers and gates required to interface the MC6845 to the Super-80.

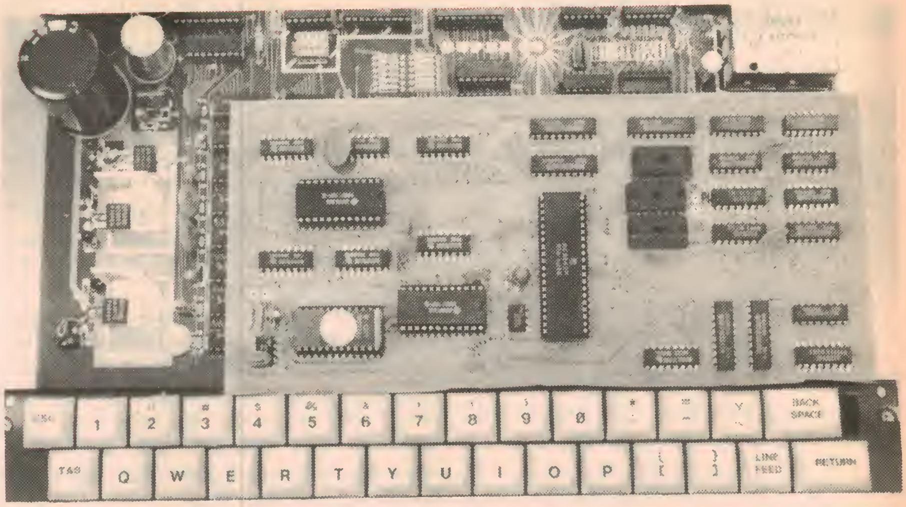
The board itself measures 235 x 110mm and is double-sided with plated through holes. The quality is excellent, and assembly and installation are straightforward, allowing for the somewhat abbreviated instructions supplied with the kit. In general, anyone who has a Super-80 kit should be able to put together the MCE enhancement board in a few hours.

Installation of the board requires the removal of 12 integrated circuits from the Super-80 and two diodes, a transistor and three resistors from the existing video mixing circuitry. There are also 12 wire links to be made on the underside of the Super-80 board and the present Super-80 monitor EPROM must be replaced.

Before going into details though it's best to say that the design does have some problems. As presently designed the enhancement board is not compatible with the Super-80 case. With the board installed it is not possible to fasten the top of the case in place.

Various other add-ons, such as the El Graphix character generator and the Dick Smith Deluxe character generator are also incompatible with the MCE board.

The MCE kit includes a revised version of the Super-80 monitor program in EPROM. To make room for the new video driver routines provided by MCE some of the Monitor commands have been eliminated. Most of these are unimportant, such as the "V" command for slowing the speed of the display. Others are replaced by functions of the 6845 chip, which includes a register containing the current address of the cursor so the Super-80 monitor cursor positioning routines have been done away with.



The video board is mounted above the Super-80 PCB with three wire-wrap sockets.

The general effect of these changes is that programs written in Basic may require modification to run on a machine fitted with the 80-column board. In general these will be minor unless the program makes use of the paging facility.

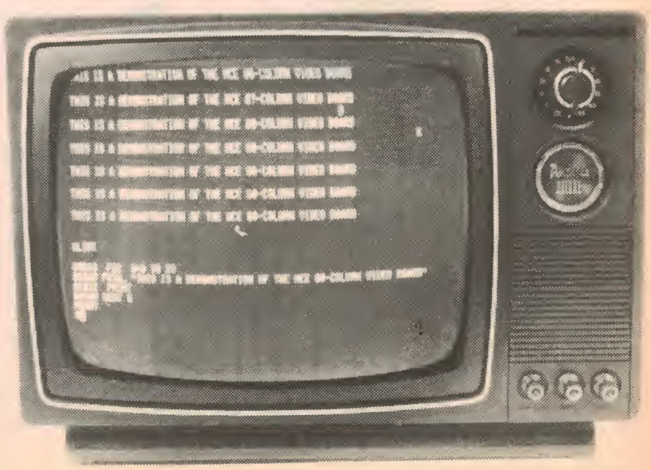
To offset these disadvantages a BELL routine has been provided. When called by a "Control-G" this routine toggles bit D_3 of the output port at F0 (hex), allowing a simple one transistor circuit to drive a speaker for audio output.

Installation and operation

Connection of the MCE video board to the Super-80 is by way of three wire-wrap sockets which plug into the sockets vacated by U34, U38 and U43. Three DIP headers with gold-plated pins are soldered to the bottom of the pins of the wire-wrap sockets to ensure firm contact. MCE also suggest that the three sockets in question on the Super-80 board be replaced by sockets with gold-plated contacts, although we ourselves did not do this.

Soldering the DIP headers to the wire-wrap pins is the only tricky part of the construction. The wire-wrap sockets are immediately adjacent to each other, and it is essential that the DIP headers be precisely aligned so that they fit into the sockets of the Super-80. Installing them requires patience, a steady hand and a small soldering iron.

The MC6845 provides the horizontal and vertical timing for the display and addresses the 2K screen memory on the



In addition to providing a display of 24 lines of 80 characters each the MCE video board offers upper and lower case, programmable characters and connections for a lightpen.

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AED Supercomputer II

. . . ctd from p 136

enhancement board. Characters are generated by a 2K EPROM, and an additional 2K of RAM is provided for programmable graphics characters. The 4K RAM space starts at address F000.

The 2K of programmable character memory starts at F800, and provides space for 128 characters, each defined on a 7 x 9 pixel grid, with almost 50% of this memory space remaining unused. MCE expects to shortly introduce a graphics program which will use these programmable characters to provide graphics with a resolution of 560 x 255, with point and line plotting commands.

Since the MC6845 accesses the video memory independently of the Z80 bus there is no need to halt the microprocessor while the video screen is refreshed. The 50% speed reduction caused by the original video circuitry of the Super-80 is eliminated, allowing operation at a full 2MHz.

All in all the MCE board is a useful addition to the Super-80. Most professional computers use an 80 x 25 display and it is almost mandatory for CP/M software. The display is stable and easily readable and adds a new dimension to the Super-80 computer. Considering the advantages provided the cost of the board and components is reasonable, at $179 for the complete kit, or $99 for the PCB, character generator and revised Monitor EPROM with manual.

Assembled and tested boards are offered for $199, and in all cases postage and packing is an additional $5. The address for further information is Microcomputer Engineering, PO Box 258, Haymarket, 2000, NSW.

memory-mapped screen necessary for this approach.

Printer flexibility

Business users will also appreciate the multiple printer switching facility, which allows selection of any one of eight printers either from the keyboard or through a program. AED suggest that the user can have one printer loaded with order forms, another with invoices and another with letterheads, ready for use in appropriate applications. Another use of this feature in word processing may be the selection of a high speed dot matrix printer for draft copies and a correspondence quality printer for final versions of a print-out.

A further convenient feature of Superaed include automatic background memory testing which is run continuously to warn of memory failures before they can cause serious problems.

In addition to these features the system reviewed here was provided with Calcstar, an electronic spreadsheet calculator, and WordStar, which is rapidly becoming the standard for business word processing applications. AED can also supply the IMS "Ascent" modular book-keeping system and the SpellStar and MailMerge options for WordStar in addition to a wide range of standard CP/M software. MBASIC 5-0 was supplied with the review machine, with other programming languages available under CP/M. Fortran '77 will be available to run under the 16-bit operating systems.

What's it all cost?

Recommended retail price of the AED Supercomputer in a single-user configuration with three 20cm disks and Superaed software is $10,729 including sales tax. The 16MB hard disk configuration may be more attractive to the business user at $12,449 including sales tax. At these prices the 16MB disk option costs just $1720. Operator training is included with the purchase of either configuration.

An added attraction of the AED system is its high local content. AED are aiming at 100% local manufacture of the boards used in the system with consequent savings in transport and maintenance costs, plus the convenience of ready access to the manufacturer. In fact, AED computers are now sporting the "Advance Australia" logo as an indication of their continuing commitment to local technological development. Their enterprise deserves to be supported.

Dial-up information service from Paris Radio

From this month Paris Radio Electronics will be providing a dial-up information service for users of 6800 and 6809 computer systems.

The service can be accessed by a 300 baud modem link between 6.30pm and 9.30am and will include complete listings of hardware and software available from Paris Radio and a bulletin board for users.

Paris Radio is Australia's largest distributor of hardware and software for 6800 and 6809 computer systems.

The dial-up service is running on a Gimix multi-user 6809 computer system and can be contacted by dialling (02) 344 9111 and logging on to the "infocentre".

For further information contact Paris Radio Electronics at Shop 1, 165 Bunnerong Rd, Kingsford, NSW 2032.

INFORMATION CENTRE

WIND SPEED INDICATOR: I recently built the Wind Speed Indicator kit, first published in EA, October 1981. The kit went together really well and the idea was very well engineered, and is able to cope with a wide range of windspeeds, including very light conditions.

However the circuit caused some problems. The power supply was spot on at 8.2V and the output of the phototransistor was very good (and square shaped!). Also the charge pump and meter worked well when fed a square wave by a signal generator.

The problem lay in the IC circuit. By shorting input pin 2 and output pin 6 (without an IC in place) the meter moved but the waveform still needed to be squared up. On inserting the IC a full scale deflection occurred which was readily adjusted with the trimpots to the correct calibration. Have you had this problem before with the circuit? (C. K., Red Hill, Qld.)

● What you have observed is not a problem. You have merely confirmed that the circuit needs the IC in order to work properly.

TRANSISTOR ASSISTED IGNITION: I wish to enquire as to whether there was ever a drive kit to run a tachometer off the EA transistor assisted ignition unit, described in December 1979. If so, could you please forward me details as to where I may obtain this kit or where I can find the details concerning it? (T. D., Queens Park, WA.)

● As you may have already noted, we have updated this project you refer to in our last issue. No, we have not published any tachometer interface circuit for the TAI for the very good reason that none is needed. Most impulse tachos will run directly from the collector of the BUX80 as this generates the same voltage waveform as seen across the points in a conventional ignition system.

Alternatively, electronic tachos may also be connected directly across the points to monitor the 12V-peak waveform.

INCORRECT DIODE: I recently encountered a simple but nonetheless interesting fault. An electronic hobbyist asked me to have a look at the EA On-Screen Graphic Analyser (March 1981, File 1/SC/11) which he had constructed. The device was only displaying nine out of 10 channels. He had checked the component orientation and his soldering but lacked the service knowledge to go any further.

A quick check with the multimeter revealed that the input to the analog multiplexer was receiving a negative rather than a positive signal. I checked the OA91 signal diode, which was acting as a half-wave rectifier, to see if it was inserted correctly. It was. After poking around some more I removed the diode and inserted another which cured the fault. The diode had been incorrectly marked. The cathode band had been placed on the anode end.

It is debatable whether this occurrence can even be considered as a fault as it happened during the construction of the project but it is still frustrating because components values are always considered to be correct.

This leads me to wonder how often components are incorrectly marked, eg, polarities and ratings on capacitors, resistor colour codes or even the wrong type number on an integrated circuit. (D. B., Berwick, Vic.)

● In our experience, component marking errors are very rare but we have seen it on resistor colour codes and on diodes. On any other component it would be difficult to tell whether it was

TAI ballast resistor may run too hot:

TRANSISTOR-ASSISTED IGNITION: A few years ago we decided to overcome some problems with a Valiant 215 car by fitting a transistor-assisted ignition system as described in EA, in December 1979. It was the circuit featuring extended dwell so that the coil current flowed for a much greater proportion of the time and the coil had a much greater duty cycle, if we may borrow a term from transformer jargon.

During investigation of poor high power performance, or more correctly, lack of power during times when the compression pressures in the cylinders of the engine were high, we measured the current drawn by the coil. It was realised that the average current through the coil was lower than the specification of the car manufacturer.

It was further realised that the average current through the coil should be very nearly the same as the current specified with the engine stopped and points closed. Then we found something else. The higher current with longer dwell resulted in greater heating of the normal dropping resistor in series with the coil (specified in the Valiant as 0.5 to 0.6 ohms) and the coil current actually fell. Since the coil also runs hotter, its resistance could also be expected to be higher.

Fitting parallel resistors (actually a complicated system of coil resistors from the local car wreckers) enabled us to adjust the coil to a running current of about 4 amps. We moved the coil from the engine block to a position on the mudguard wall.

The improvement in performance is outstanding. As an example, the top speed is now 103mph, as indicated by the speedo (pre-metric) and a tachometer which is believed to be reliable. Since the car had done about 130,000 kilometres and is fairly worn, this seems adequate to us (more than adequate . . . Ed.).

Provided we wipe the accumulation of oil from the points occasionally (the distributor may be worn), or whenever running becomes slightly rough, the performance of the ignition system is now what it should be. (A. B., North Mackay, Qld.)

● As you are now aware, we updated this ignition circuit last month. Your comments about the ballast resistor are pertinent, especially to those using open-wire construction. These would become much hotter at higher currents and thus their resistance would increase. Even so, we would not have expected the marked effect you report and we wonder if the original ballast resistance was not suffering from the effects of many years of exposure and resultant oxidation.

incorrectly marked or just faulty. For example, a wrongly polarised capacitor would appear to be leaky and have poor power factor. As for a wrongly marked IC, it would probably refuse to function at all.

The moral of your story would appear to be that components should be checked wherever possible before they are installed. Perhaps other readers have had similar experiences that they would like to share with us.

MODEL 15 TELETYPE: As radio amateurs from the bush, we constantly make do with equipment that is well outdated. At present we are debating the feasibility of using a Model 15 Teletype as a printer for a Dick Smith Super-80 computer. Any information on how to connect such a combination would be appreciated. (A. V., Whitton, NSW.)

● Two articles have been published on interfacing to the Model 15 Teletype. They are the ASCII/Baudot translator (October 1976) and the RTTY demodulator (March 1977). Photostats of these articles are available from our Information Service for $3.00 each.

RTTY DEMODULATOR: I have completed construction of this unit described in the March 1977 issue, except for one item, the DTS410 transistor. This seems to be unobtainable, nor can dealers even quote an equivalent. Could you please advise me of a couple of alternatives for it? (J. F., Coleambally, NSW.)

● Since the application requires a transistor with a collector voltage rating of more than, say, 80V and a modest current rating, any general purpose high-voltage, medium power transistor will suffice. We suggest the BF469 or MJE340. Both have been used in our Playmaster amplifier designs of recent years and are readily available.

VIDEO MONITOR: I have a System-80 computer at home and use a television set for the monitor. I would like a sharper picture than I have at present and have heard that this is possible to achieve by bypassing the tuner section of the television. Can you explain how to do this? (B. B., Nedlands, WA.)

● We covered the necessary procedure quite thoroughly in our third article on the DREAM 6800 computer back in July 1979. Since some checks are necessary before connecting the computer to the TV set (such as the polarity of the video signal and whether the television chassis is isolated from the 240VAC mains) we suggest you obtain a copy of this article and read it before attempting anything. Photostat copies are available from our Information Service at $3.00.

300VA INVERTER: Please provide some technical assistance before I tear my hair out. I have constructed the 300VA inverter from the February 1979 issue. The device functions well until about 60W output. At this point it drops out of oscillation. Although the regulating light is normally on, when the device drops out the overload light remains at half intensity. Also before dropping out the frequency rises swiftly.

I have rebuilt sections of the device, replaced this and that, and tried new microcircuits. (S. S., Hunters Hill, NSW.)

● Since the oscillator drops out of oscillation, we would expect that the power supply is dropping when the output load is increased. This may be due to the thermal overload light producing a voltage drop. However, you do not say whether the overload light is the thermal overload or current overload light. Try replacing the thermal overload lamp with a 1.5A fuse. We also refer you to the updated inverter of the June 1982 issue which uses a similar circuit to that of the February 1979 issue.

CAR COMPUTER: I am writing to request help with one of your recent projects, the EA car computer. I wish to add an over-speed alarm, low fuel warning etc. I am not too familiar with the 6802 microprocessor and find it a little difficult to decipher the program. The non-mask interrupt and interrupt routines are easy to follow, however the main body of the program has unusual programming techniques which are a bit hard to grasp.

Could you possibly supply an assembled version with text of the program. If this is not possible could you briefly explain:

(1) Initialisation of PIA.
(2) Loading of function into display memory 2A, 2B, 2C, 2D, 2E.
(3) Loading of parameters into memory (Fuel cal, Distance cal, litres).

Any assistance would be appreciated. (M.J.D., Narrabri, NSW.)

● A fully commented listing of the Car Computer EPROM program would take a great many pages of this magazine which we are unlikely to be able to justify. Unfortunately we are unable to answer any of your requests in detail at present. However, if there was sufficient reader interest, as indicated by letters (not phone calls, please ... Ed.) we

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could consider an explanatory article on the main features of the EPROM program.

LOW DISTORTION AUDIO OSCILLATOR: I recently decided to construct the Low Distortion Audio Oscillator project described in EA June 1981. To avoid the necessity of indulging in metalwork, I thought that a kitset would be the wise way to go, but I was mildly disappointed. I purchased a Dick Smith kit and was rudely shocked when I discovered that the well made pre-punched design was not specifically for that design but exactly to the letter of the EA original article. Quote: "We housed our audio, oscillator in a Musicolour chassis (available from most kit retailers), though any metal case of similar dimensions would be appropriate" end of quote.

On to other points regarding this project: I noted the errata in December '81 albeit that it was fairly vague, and would suggest some further additional attention. I make this suggestion and raise a query. Change the PC terminal No. 18 from the shield of the screened cable to S2a over to the centre conductor at the collector of Q11. Now the query. If it is important to use shielded cable to go from the collector of Q11 out to S2a why is it not just as important to use shielded cable to return from S2a to PC terminal 7 at IC1a pin 3? Surely the screen should extend right up to the inverter input from Q11 collector via S2a when in the square wave position.

On my wiring connection diagram I labelled the switch S2 "SINE" towards the bottom of page 52 and "SQUARE" towards the top with the existing screened cable connection at S2 renumbered 17 instead of 18 and added a new piece of screened cable section in place of the wire marked 17 (both screens connected at S2 as now shown). The screen of this new piece is connected at the PC board end (Terminal 18). This makes the wiring diagram agree with the schematic as intended.

There is one further omission from the schematic and also the PC board pattern although I am sure it was surely a slip and not intentional. All unused inputs (pins 13, 11 and 9) of IC1 were obviously intended to be connected to +15V rail but were inadvertently missed.

The final outcome of the project was completely successful and without any problems but I was a little dismayed at the time taken for the oscillator to settle at any change in frequency. Is there any suggestion which might be incorporated to dampen the "boinging" more quickly. I have noticed with at least a couple of commercial audio oscillators that the "boinging" is also pronounced and settles more quickly. (R. H., Carine, WA.)

● Ostensibly, it makes sense to specify the sheilded cable as you suggest and have it run to and from the switch. However, as the project recedes into the "mists of time" (we hope this turn of phrase appeals) we can only surmise that the one length of cable was found to be adequate. Your approach would appear to be entirely practical though.

As far as the unused inputs of the IC are concerned, it is not our practice to show unused inverters or gates within a package on the circuit. This is in line with normal drawing practice.

The envelope stability (or "boinging" as you call it) is mainly a function of the thermistor and the dual potentiometer and there is little that can be done to improve this aspect apart from closer matching of the potentiometer elements.

Power-Up appearance not a turn-on

POWER-UP: I read your "Power-Up" project (November 1982) with interest and thinking it useful, built it. However, what struck me after reading the article was the trouble, expense and "amateurism" that screams out with a zippy box with power points hanging over the edge. Instead, I built my version into a Kambrook powerboard (you know the ones, four power points in a moulded package on a 2m cord).

In these units, the power points are connected by strips of copper (or brass), screwed into place. Take these out, saw off the end ones and run a separate power line to it from the circuit. Admittedly, fitting the PCB was a bit of a squeeze, and I used a smaller relay than in your version but with 10A contacts and laid on its side. But there is a brand of powerboard which has three sockets and one blank (where the fourth would normally be) which is used as the position for a timer mechanism on the more expensive version. This space would be ideal for the circuit.

The "power available" neon on these units also takes on a new meaning — only lighting up when there is power available on the controlled GPOs.

It would also have been nice if you had made the 220Ω sensitivity resistor variable so the unit would activate on a change of power consumption, ie, cassette deck starting to play or especially, a clock radio. In the latter case, when the alarm activates the radio dial would light up and using more current would activate the record player via the Power-Up. Keep the circuits coming. (D. C., Rosanna, Vic).

● While we agree that more attrctive packaging of the Power-Up project is desirable, we feel that the result we achieved with the readily available materials is acceptable. Your approach would lead to an attractive finished package but does have problems in the execution of the circuitry and gives less controlled outputs, ie, a maximum of three. It is also more expensive. Still, some readers will be interested in your ideas.

We do not think the circuit can be made to work reliably on the very small change in power consumption which may result from the examples you cite. If you were to try to adjust it critically it may very well trigger on mains "transients".

Meridian M.3 . . .

Continued from page 38

be unadorned and simply engineered, the Meridian will probably appeal.

Its price is not cheap by any means and seems to be considerably dearer than the equivalent UK price but it is competitive with a comparable set of loudspeakers plus a high powered amplifier and control unit. The recommended retail price of a pair of Meridian MS InterActive loudspeakers is $1965.00 while the Meridian 101 Control Unit retails for $795.00. Both prices include sales tax.

Meridian high fidelity equipment is available from selected retailers in each state. For further information and the address of the nearest Meridian retailer, contact the Australian distributors, Audio 2000, PO Box 107, Brookvale 2100. Phone (02) 939 2159. (L.D.S.)

Notes & Errata

EPROM Programmer Hex Display (January 1983, CDI page 79). Due to a lapse in our checking procedures, a number of errors and omissions are present in the published circuit diagram. Two diodes are shown between segment "B" and pin 17 of IC8 but one of them should go to pin 16 (of IC8). The resistor to the base of Q2 should be 3.3kΩ and the capacitor at pin 2 of IC1 should be .0033μF. There should not be a line through IC4, joining pins 2 and 3 and the line from pin 3 of IC1 goes to pin 1 of IC2 (pin not labelled). A3 goes to pin 5 of IC7 and not pin 1. Display wiring from IC3 should be as follows: pin 1 to D1, pin 2 to D2, pin 5 to D5, pin 6 to D6 and pin 7 to D7.

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